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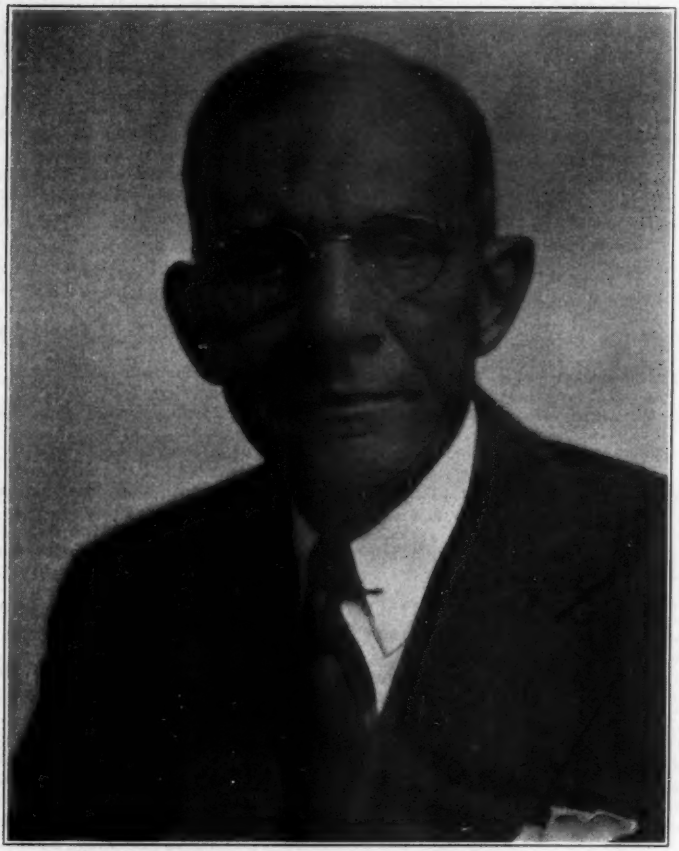

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SULFONAMIDES IN DENTISTRY

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THE year 1935 will be a memorable one in the history of medicine because it marks the introduction of sulfanilamide into medical practice. By now, the far-reaching results of the application of this drug and its derivatives are known to every layman, and, for the first time, there is a reasonable hope that future years will see the development of a specific drug for every human infection. More than 2,000 sulfonamide drugs have already been synthesized by the chemist. Obviously, all of them have not been thoroughly studied, but from the group five, sulfanilamide, sulfapyridine, sulfathiazole, sulfadiazine and sulfaguanidine, stand accepted by the Council on Pharmacy and Chemistry of the American Medical Association. The Council on Dental Therapeutics has recently voted to consider brands of sulfanilamide, sulfapyridine and sulfathiazole for inclusion in Accepted Dental Remedies.[1] Several other members of the sulfonamide group show distinct promise of usefulness, and more will probably be heard of them in the near future.

In the dental field, the introduction of the sulfonamides has not produced the spectacular results that have attended their use in medicine, but, as they are more extensively applied to dental problems, it becomes increasingly apparent that they have legitimate and valuable dental uses. However, it likewise becomes apparent that they have definite limitations and that they are not a panacea for dental infections.

In both medicine and dentistry, this group of drugs have been used in two ways; i.e., by oral or intravenous administration, for their systemic effects after absorption by the blood stream, and locally, in open wounds, for their effect at the point of application. The original and most extensively used method is by mouth, for a systemic action. In the dental field, their systemic use is well established in the treatment of extensive infection involving the soft or bony tissues of the oral cavity. There is now sufficient evidence of the specific action of these drugs on certain organisms to make it

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advisable to choose the drug used on the basis of the organism present. However, if this information is not immediately available, treatment should not be delayed until cultures are taken. On the basis of present evidence, New and Non-Official Remedies 1942[2] gives the recommendations summarized in Table 1 for application of the various sulfonamides to specific infections.

An interesting internal use of the sulfonamides has recently been suggested by Budnitz, Nizel and Berg,[3] who advise their prophylactic use before extractions in patients who might be susceptible to subacute bacterial endocarditis. It is known that persons with valvular cardiac defects are susceptible to the implantation and growth of bacteria on the heart valves which form vegetations there and cause the almost uniformly fatal condition known as subacute bacterial endocarditis. Any transient bacteremia may cause such an implantation, which is usually found to be a *Streptococcus viridans* infection. Okell and Elliott[4] and Palmer and Kempf[5] have demonstrated that transient bacteremia follows tooth extraction. Furthermore, numerous investigators have reported subacute bacterial endocarditis following tooth extraction, in some instances as high as 25 per cent of cases having a history of recent extractions. Budnitz, Nizel and Berg report a series of twenty-seven cases in which sulfapyridine was used prophylactically before extraction. Blood cultures were taken immediately after extraction and from twenty to thirty minutes later. No positive blood cultures were obtained in this group of cases. Other investigators are now working on this problem, and no doubt further information will soon become available. In the meantime, the preextraction prophylactic use of one of the sulfonamides would seem to be indicated in those patients with valvular heart defects. Further work is necessary to determine which of the compounds is most desirable, but, on the basis of present knowledge of toxicity and effectiveness, sulfathiazole or sulfadiazine would seem to be the drug of choice.

When there are indications for the internal use of the sulfonamides in dentistry, it should be remembered that all of these compounds are potentially toxic and that serious reactions may occur from their indiscriminate use. Furthermore, these toxic effects are entirely unpredictable, and there is considerable variation in the rapidity of absorption and excretion in various patients, making frequent blood level determinations desirable. This can be done by the method described by Bratton and Marshall,[6] and is essential in severe infections because of the fact that none of the sulfonamides is effective at a blood level of less than approximately 4 mg. per hundred cubic centimeters, and maximum effectiveness is usually not obtained until

TABLE 1.—INDICATIONS FOR USE OF SULFONAMIDE COMPOUNDS

Infection	Drug of 1st Choice		Drug of 2nd Choice
Hemolytic streptococcus (Lancefield's group A)	Sulfadiazine		Sulfanilamide
Pneumococcus	Sulfadiazine		Sulfathiazole
Gonococcus	Sulfathiazole		Sulfapyridine
Staphylococcus	Sulfadiazine	or	Sulfathiazole
Meningococcus	Sulfadiazine		Sulfathiazole
Friedlander's bacillus	Sulfadiazine		Sulfapyridine
Alpha hemolytic streptococcus	Sulfadiazine		Sulfathiazole
S. dysenteriae	Sulfaguanidine		Sulfathiazole
Enterococcus	None		
Anerobic streptococcus	None		

a blood level of from 8 to 10 mg. per hundred cubic centimeters is reached. In prolonged sulfonamide therapy, blood counts are also necessary because of the possibility of development of an acute hemolytic anemia, a severe leukopenia or a granulocytopenia, which may occur at any time during the course of therapy, but are probably more common after several days of treatment have elapsed.

Thus, it appears obvious that, in general dentistry, the internal administration of the sulfonamides should be carried out in cooperation with the patient's physician, who is usually in a position to handle possible toxic reactions and to advised to keep out of the sun and not to receive ultraviolet irradiation. Cyanosis is generally present to some degree in sulfanilamide therapy.

Other severe complications of sulfonamide therapy include drug fever, hepatitis with jaundice, hematuria and renal calculus formation. The last mentioned complication occurs more frequently with sulfapyridine therapy and is also sometimes noted in sulfathiazole therapy. It is thought to be due to the formation of acetylsulfapyridine and acetylsulfathiazole by conjugation in the liver. Since the drug is insoluble in this form and is primarily excreted by the kidney, it may

TABLE 2.—TOXIC SYMPTOMS OF THE SULFONAMIDES

Toxic Symptoms	Sulfanilamide	Sulfapyridine	Sulfathiazole	Sulfadiazine	Sulfaguanidine
Nausea, vomiting	xx	xxxx	x	Rare	Rare
Headache and dizziness	xxx	xxx	x	Rare	—
Cyanosis	xxxx	xx	x	Rare	—
Drug fever	xx	x	xxxx	x	Rare
Rashes, photosensitization	xxx	xx	xxxx	x	Rare
Acidosis	xxxx	—	—	—	(Least toxic of
Hepatitis and jaundice	xx	xx	x	—	common sulfa
Acute hemolytic anemia	x	x	—	Rare	drugs)
Leukopenia	x	xx	x	x	
Granulocytopenia	x	x	x	x	
Hematuria and kidney calculi	—	xxx	xx	Rare	
Injection of sclera	—	—	x	—	

make the necessary routine tests during the course of therapy.

Some patients who receive sulfonamide therapy show symptoms of central nervous system involvement which may include nausea and vomiting, dizziness, depression or elation or even severe toxic psychoses. Consequently, patients receiving sulfonamide therapy should be warned against driving cars or doing work in which a period of dizziness or confusion might cause a serious accident. Particularly in the course of sulfathiazole and sulfanilamide therapy, some patients may exhibit severe skin rashes, which are often the result of photosensitization, and, for this reason, patients should be crystallize in the tubules, calculi forming with resultant extensive irritation and kidney dysfunction. Obviously, such a complication is dangerous, but it can usually be prevented by administration of sufficient fluid to keep the urine output at not less than 1 liter per day.

Although the toxic manifestations of the sulfonamides are essentially similar, they vary considerably in frequence and severity among members of a group. Sulfadiazine administration appears to cause fewer toxic reactions than does sulfanilamide, sulfapyridine or sufathiazole, although recently several cases of severe agranulocytosis have been reported in conjunction with sulfadiazine

therapy. Sulfaguanidine, the least toxic of the common sulfonamides, is poorly absorbed and is, therefore, not extensively used for its general action, but rather for its local bacteriostatic and bactericidal action in the gastro-intestinal tract. Table 2 gives a summation of the common toxic effects of the best-known sulfonamides.

Dosage of all sulfonamides depends on the type and severity of the infection and should be worked out in cooperation with the patient's physician.

Because of the accessibility of the tissues of the oral cavity with which dentistry is primarily concerned, the profession early became interested in the topical, or local, uses of the sulfonamides. Both in medicine and in dentistry, there has been and still remains considerable confusion as to the effectiveness of local sulfonamide therapy, but sufficient information is now available to postulate some tentative conclusions.

In attempting to evaluate this type of therapy in dentistry, it becomes necessary to consider several problems. One of the first to arise was the question of possible systemic toxic effects from the absorption of the drugs from the surfaces to which they are applied. Theoretically, such toxic effects might occur, but the quantity of sulfonamides used in or about the mouth is so small as to make such a possibility very remote. It is not uncommon for the abdominal surgeon to use as much as 12 gm. of sulfanilamide intraperitoneally and in the abdominal walls[7] without systemic toxic reactions. Garvin[8] implanted 5 gm. of sulfathiazole in various wounds and was unable to demonstrate a significant rise in blood level. Obviously, these quantities are larger than would be used in or about the mouth, this fact indicating that there is little possibility of systemic toxicity from local application of the sulfonamides in dentistry.

A second question of considerable importance is, "What effect does the local use of a sulfonamide have on the healing of a wound?" Early investigators were in general of the opinion that there were no harmful effects from the use of sulfonamide powder or pastes. However, some more recent articles have indicated that application of large quantities of the drug may interfere with healing and may produce a foreign-body reaction. Bick[9] reports a serious inhibition of healing and an increase in scar tissue formation in operative and traumatic wounds of the soft tissues treated with sulfanilamide and sulfathiazole. Fifty cases were treated by a standard technic plus the application of from 1.5 to 10 gm. of powdered sulfanilamide or sulfathiazole. A series of fifty control cases were treated with exactly the same technic except that the sulfonamide was omitted. The records of healing showed a delay of from 50 to 75 per cent of the time factor when either sulfanilamide or sulfathiazole was used, plus an increase in the amount of scar tissue formed. For these reasons, Bick believes, local sulfonamide therapy is not indicated unless there is reason to believe that a wound is infected. On the other hand, he believes that its use is obligatory in contaminated wounds.

Taylor[10] implanted approximately 1 grain quantities of the common sulfonamides beneath the anterior rectus sheath of dogs, along with small pieces of paraffin as controls. Sections were removed three days later for microscopic study. The paraffin produced practically no reaction, but all of the sulfonamide drugs produced an inflammatory reaction, with severe edema and accumulation of inflammatory cells. In the case of sulfathiazole and sulfadiazine, actual abscesses were formed about crystals, which still persisted in the tissues. No crystals of sulfanilamide, sulfapyridine or sulfaguanidine remained at the end of the three-day period. The inflammatory changes were slightest in the case of sulfanilamide. Taylor believes that, in view of

these findings, the placing of one of these compounds in a clean wound is not justified, but he feels that they may be of use in ulcerated areas or contaminated wounds.

Glynn,[11] using sulfanilamide, sulfapyridine and sulfathiazole experimentally in the muscles of rabbits, found a slight inhibition of fibroblast proliferation as a result of the action of sulfathiazole and sulfapyridine, but not of sulfanilamide. Sulfanilamide and, to a lesser extent, sulfapyridine therapy had a slight toxic effect on striped muscle. However, Glynn finds that, in no case, were the reactions sufficient to contraindicate the local application of the drugs.

Krashen,[12] who has reported one of the few well-controlled studies of the postextraction application of the sulfonamides, states that the use of sulfanilamide in the alveolus increases pain and delays the healing of the extraction socket. In a second and more extensive study of sulfonamide therapy in the extraction socket, he[13] confirms his original opinion and concludes that sulfonamide therapy is not routinely indicated in the average uncomplicated extraction, and that large masses of the sulfonamides are never indicated in a wound.

Others, including Taffel and Harvey,[14] Key and Frankel[15] and Jacoby, Medawar and Willmer,[16] indicate that sulfonamide therapy may cause some local irritation, but not enough to contraindicate their topical use.

To summarize: The present opinion of most investigators seems to be that the use of any sulfonamide in wounds is capable of causing some irritation, but this is not sufficiently harmful to contraindicate its use where infection exists or where it may be anticipated because of contamination of the wound. On the basis of present information, the use of sulfanilamide seems least harmful to the wound and of sulfathiazole and sulfadiazine seems to have the greatest reaction. This may be due to the fact that sulfathiazole and sulfadiazine are considerably less soluble than sulfanilamide in both water and human serum at both room and body temperatures.[17] The greatest solubility of all of these compounds at body temperature is that of sulfanilamide, 1.46 per cent in water and 1.97 per cent in human serum. Since these solubilities are low, it becomes obvious that small quantities are sufficient to produce a saturated solution. The present tendency is to use these compounds in smaller dosage for topical application. This may readily be done by dusting the area with dry powder in an atomizer. Others have preferred to wash the area with a suspension in physiologic sodium chloride solution or hydrogen peroxide and some have applied the drug in ointment form. On the basis of present evidence, the solid packing of a socket with the drug would seem contraindicated. Since the sodium salts of sulfathiazole, sulfapyridine and sulfadiazine produce a pH of from 9 to 11, they are extremely irritating and coagulate human serum when in saturated solutions.[17] For this reason, they are contraindicated for local application. At the present time, sulfanilamide or sulfathiazole would seem to be the drug of choice for topical use. It is generally believed that the powders should be sterilized before application to a wound. Some manufacturers are providing sterilized powders in sealed containers, or the powder can be sterilized by heating to 140° C. for two and one-half hours in dry heat. Moist heat will cause caking.

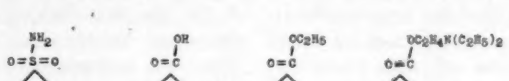
The third and most important question to be considered in evaluating local sulfonamide therapy in dentistry is "Under what conditions and to what extent are the sulfonamides effective when applied topically?" Several facts must be considered in attempting to answer this question. Many investigators have shown that the sulfonamides *in vitro* possess both bacteriostatic and bactericidal properties,[18] and it is therefore assumed that

they are likewise bacteriostatic and bactericidal when applied to open wounds or infections. Topical application of sulfanilamide may cause a concentration in the tissue fluids of 500 mg. or more per hundred cubic centimeters, and sulfathiazole, a concentration of 100 mg. per hundred cubic centimeters[17] as compared with the 10 to 15 mg. per hundred cubic centimeters possible with safety in the blood stream. However, the *in vivo* bactericidal and bacteriostatic action of the sulfonamides will be modified by several facts. Reports have recently appeared indicating the existence of sulfonamide inhibitor substances, which include devitalized tissue, exudates and bacterial products, that is probably due to the presence of para-aminobenzoic acid. The latter substance is of particular interest to the dentist since our local anesthetics, such as procaine and benzocaine, are esters of this compound and, when placed in the tissues, they may break down into the parent substance.

Numerous investigators, including Woods and Selbie, as reported by Nevin[19] and Janeway,[20] have called attention to the fact that para-aminobenzoic acid is a necessary growth factor for bacteria, and Woods believes that because of the structural similarity of the molecules, organisms will absorb sulfanilamide when the supply of para-aminobenzoic acid is low. This drug then inhibits the metabolic processes of the organism and causes its eventual destruction. Since local anesthetics may break down into para-aminobenzoic acid, which is absorbed by the organism instead of the sulfonamide, it is believed irrational to use a sulfonamide and benzocaine concurrently in a wound, as has been advocated by some. Likewise, it is believed that the concurrent administration of the vitamin B complex and sulfonamides is contraindicated, since it has been found also to be a sulfonamide inhibitor. (See accompanying structural formulae.)

Several investigators, including Fleming,[21] Spink,[17] MacLeod[22] and Tsuchiya, Tennenberg, Clark and Strakosch,[23] have called attention to the fact that masses of bacteria, pus and necrotic tissue, as well as some drugs, have antisulfonamide properties. These observations emphasize the necessity of thorough débridement of contaminated or purulent wounds before the topical application of a sulfonamide. Others, including Holder and Mackay[24] and Strakosh and Clark,[17] have noted that the antisulfonamide properties of these substances are greatly diminished by the presence of urea (carbanide) and that sulfonamides plus urea are more effective locally than sulfonamides alone. Holder and Mackay have suggested the use of a preparation of 90 per cent urea with 10 per cent sulfanilamide, or 5 per cent sulfanilamide and 5 per cent sulfathiazole. Strakosh and Clark have used urea 70 per cent, lactose 20 per cent and sulfathiazole 10 per cent, either as a powder or in suspension with 1 part of powder to 2 parts of water.

The presence of urea is said to have a solvent action on necrotic tissue, pus and débris, but the therapist is warned against continued use of urea after granulation tissue appears, since it is said to



Sulfanilamide p-Aminobenzoic acid Ethyl aminobenzoate (Benzocaine) Procaine (base)

suppress the growth of epithelium and to stimulate granulation in uninfected wounds. Dentistry should follow closely the development of the use of urea in combination with the sulfonamides, as it may well greatly enhance the value of local sulfonamide therapy.

The local use of the sulfonamides has been proposed for a number of different purposes by numerous clinicians and investigators. As would be expected, one of the most extensive uses has been the prophylaxis of postextraction sockets and the therapy of infected sockets. In attempting to evaluate this use of the sulfonamides, unusual difficulties are encountered. In the first place, the tissues of the oral cavity are noted for their ability to withstand extreme trauma and bacterial contamination and still heal rapidly. In no other tissue of the body are such resistance to infection and recuperative power observed. Thus, it becomes difficult to determine whether successful healing has been due to the resistance of the oral tissues or is a result of the local application of the sulfonamides. Consequently, most reports have been based on clinical observation of patient reaction in terms of pain, rapidity of healing and lack of complications. While of interest and value, these reports hardly give a basis for final evaluation of a group of drugs.

It is not within the scope of this paper to review all of the reports on the use of sulfonamides in the postextraction socket. A previous review[25] has covered those reports appearing before 1942. Most clinical reports have been favorable, indicating a decrease in postoperative complications such as dry socket and infection and a decrease of postoperative pain, and either no inhibition or, in some instances, actual stimulation toward healing of the socket. Only a few of these reports have carried a concurrent series of cases as controls in which no sulfonamide has been used. Stern[26] reported one such series in which sulfanilamide, sulfathiazole and sulfapyridine were used. He reports the results of sulfonamide therapy to be reduction of postextraction pain, a reduction of constitutional reaction as indicated by a rise in temperature and a reduction in the period of required postoperative treatment. He felt that results were slightly better when sulfanilamide was used.

Weiner[27] has recently reported on the use of the sulfonamides in a series of 1,065 extractions. Approximately one-third of the sockets were packed with powdered sulfanilamide and another one-third with sulfathiazole. The remainder of the series received no sulfonamide, acting as controls. Five cases of infection developed in the control series, while only one developed in the group treated with the sulfonamides, this leading Weiner to the conclusion that local application of the sulfonamides tends to prevent postextraction complications.

Greiss[28] reported a controlled series of 1,672 extractions in which sulfanilamide was packed in the sockets in from 5 to 30 grain quantities. As compared with the control series, those that received the sulfanilamide showed less postoperative pain, a reduction in postoperative temperature and less reactionary trismus and swelling.

Krashen's[12, 13] two series of controlled observations of extraction sockets have previously been noted. His results obviously do not agree with most other reports since he noted an increase in pain and swelling and slower healing when sulfonamides were used. His second report indicates that local sulfonamide therapy may be desirable in subacute or acute conditions involving hard and soft tissues of the oral cavity. He emphasizes the important point that the local use of the sulfonamides never permits relaxation of surgical technic or asepsis or the omission of postoperative care.

In brief, the majority of reports on the postextraction use of the sulfona-

mides have been favorable and, in view of present evidence, their use for this purpose seems indicated, especially if infection is present or may be anticipated, because of the existence of periapical involvement or extensive operative trauma. The necessity for their routine use in uncomplicated extractions is questionable. The drug of choice seems to be sulfanilamide or sulfathiazole. The packing of large quantities into the socket appears contraindicated, particularly in the case of sulfathiazole, which, experimentally, has been shown capable of causing considerable local tissue irritation.

In localized cases of osteomyelitis and cellulitis which are accessible, sulfonamides may be used topically,[29] but the drugs should also be used by mouth in sufficient quantity to bring the blood concentration to an effective level.[17] It must be remembered that extensive cellulitis of the face or neck is a serious condition, and local application should not be relied upon alone.

Many investigators and clinicians[30, 31, 32, 33, 34, 35] advocate the prophylactic use of sulfonamides locally in contaminated wounds, such as compound fractures and gunshot or shrapnel wounds, and in industrial accidents. The experiences reported from England and from Pearl Harbor rather uniformly support the effectiveness of this type of application, though there is no complete agreement as to method of application or choice of drug. A majority appear to prefer sulfanilamide, because of its greater solubility and slighter tendency to produce localized irritation. However, Goodsell[33] indicates a preference for sulfathiazole and Key[36] suggests the use of two parts of sulfanilamide and one part of sulfathiazole. As previously stated, thorough débridement of the wound should precede the application of the sulfonamide.

Adams,[37, 38, 39, 40] has proposed the use of hot sulfanilamide solutions to irrigate the canals and periapical areas of pulpless teeth. The fact that sulfanilamide solutions, and particularly hot sulfanilamide solutions, have bacteriostatic and bactericidal properties is well known, and there seems to be no reason to doubt that these solutions will sterilize such areas. However, there still seems to be some question as to the superiority of this method over older and less cumbersome ways of draining and sterilizing periapically involved teeth. In his last report,[40] Adams gives the results of treatment of fifty-two cases in which x-ray examination revealed extensive periapical involvement.

Although we are well aware of the difficulty of drawing any conclusions from work that is done by different operators and under different conditions, we again submit some comparative results for a technic in use at the University of Michigan, School of Dentistry. Adams reports that "a negative culture following one treatment was had in 42 per cent." Figures taken from a series of case records at the University of Michigan clinic show that two successive negative cultures were obtained after the first treatment in 72.1 per cent of 289 normal peridental membrane cases; in 64.8 per cent of thirty-seven cases diagnosed roentgenographically as chronic proliferative periosteitis, and in 61.9 per cent of twenty-one cases diagnosed as granuloma. Adams further reports that "the average for the fifty-two cases is 3.18 treatments." The average for the University of Michigan series is 3.44 treatments for normal peridental membrane cases, 3.46 treatments for proliferative periosteitis cases and 3.66 treatments for granuloma cases.

These figures are inclusive of the visits at which negative cultures were obtained. The cases were treated by thorough washing at each visit with a water-soluble chlorazene solution, and, in a majority of cases, camphorated p-monochlorophenol was sealed in the tooth for a forty-eight hour period between visits. All cultures of teeth showing periapical involvement are taken from outside the

apex by means of an absorbent paper point and incubated, plated and identified by the bacteriology department.

It is freely admitted that these figures prove nothing concerning the relative merits of the two methods of treatment, but their almost surprising similarity merely indicates that clear-cut superiority for the sulfonamides in root-canal and periapical therapy has not yet been demonstrated. Since there is a possibility that sulfonamide therapy may prove valuable in root surgery, further work in this field seems to be indicated, particularly work in which a control series is maintained with alternating cases treated by a standard technic without sulfonamides. In the meantime, we are inclined to share the opinion of Spink that "further clinical evaluation of sulfonamide therapy in pulp-infected teeth is needed before its efficacy can be properly assessed."[17]

Attempts to apply the sulfonamides to periodontal disease, including Vincent's infection, have, in general, been disappointing. Mewar[41] and Knebelman[42] have reported successful use of the sulfonamides in periodontal disease, and, more recently, Greenhaut[43] reported the successful treatment of twelve cases of Vincent's infection with sulfa drugs in a paste with hydrogen peroxide. Since no series of controls is presented, and since hydrogen peroxide has long been a favorite remedy for Vincent's infection, a question arises as to whether the results can be attributed to the sulfonamide. Since there are so many predisposing factors in periodontal disease, it seems that successful treatment will remain largely a matter of correct diagnosis and removal of these factors, and that the application of any drug will be of a secondary importance. However, further study of the sulfonamides in periodontia seems desirable.

In strictly military dentistry, the sulfonamides have been applied by dental officers in most of the methods that have been reviewed in this paper. However, it is in the prophylaxis of contaminated wounds in and about the mouth that they find their most spectacular use. Every American soldier who goes into action is provided with 12 sulfanilamide tablets to take by mouth in case he receives a wound, and 5 gm. of sulfanilamide powder, which is to be implanted in the wound immediately.[44] As has been previously stated, reports from the battle fronts credit this procedure with markedly decreasing the incidence of gas gangrene and other wound infections.

SUMMARY

1. The use of the sulfonamides internally in extensive infections of dental origin is a firmly established procedure. The drug of choice and the dosage will depend on the type and severity of infection. In most cases, the medication should be carried on in cooperation with the patient's physician because of the toxicity of the sulfonamides.

2. Present evidence indicates that patients with valvular cardiac involvements should be premedicated with a sulfonamide before extractions as a prophylaxis against subacute bacterial endocarditis.

3. A majority of reports indicate that topical application of the sulfonamides is valuable in the infected or potentially infected extraction socket. Large quantities are not indicated and the question of its use following the average uncomplicated extraction needs further clarification.

4. Topical application of the sulfonamides is indicated in contaminated wounds in and about the mouth, including war wounds and those received in civilian accidents.

5. Topical application may be of value in localized subacute or acute infections about the mouth.

6. Sulfonamide therapy in root-canal and periapical involvements is still in the experimental stage. Further work is necessary to determine whether it is superior to established procedures.

7. Most attempts to use the sulfonamides in periodontal involvements have been disappointing. Further careful study seems desirable.

8. In no case is the use of a sulfonamide a substitute for careful operative, surgical or aseptic technic, or for adequate postoperative care.

9. No phase of sulfonamide therapy should be considered as a closed subject. Further investigation of existing compounds and the introduction of new sulfonamides may change present theories and practices at any time.

BIBLIOGRAPHY

1. Report of Thirteenth Annual Meeting of Council on Dental Therapeutics. J.A.D.A., 29:1271, July 1942.

2. New and Non-Official Remedies. Chicago: American Medical Association, 1942, pp. 139-142.

3. BUDNITZ, EDWARD; NIZEL, A. E., and BERG, LEO: Prophylactic Use of Sulfapyridine in Patients Susceptible to Subacute Bacterial Endocarditis Following Dental Surgical Procedures. Preliminary Report. J.A.D.A., 29: 346, March 1942.

4. OKELL, C. C., and ELLIOTT, S. D.: *Lancet*, 2:869, October 19, 1935.

5. PALMER, H. D., and KEMPF, MYRA: *J.A.M.A.*, 113:1788, November 11, 1939.

6. BRATTON, A. C., and MARSHALL, E. K., JR.: *J. Biol. Chem.*, 128:537, May 1939.

7. THOMSON, J. E.; BRABSON, J. A., and WALKER, J. M.: *Surg., Gynec. & Obst.*, 72: 722, April 1941.

8. GARVIN, C. F.: *Am. J. Orthodontics*, 28: 102, February 1942.

9. BICK, E. M.: *J.A.M.A.*, 118:511, February 14, 1942.

10. TAYLOR, F. W.: *J.A.M.A.*, 118:959, March 21, 1942.

11. GLYNN, L. E.: *J. Path. & Bact.*, 53: 183, September 1941.

12. KRASHEN, A. S.: Preliminary Report on Use of Sulfanilamide in Preextraction Case. J.A.D.A., 27:1199, August 1940.

13. *Idem:* Local Use of Sulfonamides. J.A.D.A., 29:1427, August 1942.

14. TAFFEL, M., and HARVEY, S. C.: *Proc. Soc. Exper. Biol. & Med.*, 47:202, June 1941.

15. KEY, J. A., and FRANKEL, C. J.: *Ann. Surg.*, 113:284, February 1941.

16. JACOBY, F.; MEDAWAR, P. B., and WILLMER, E. N.: *Brit. Med. J.*, 2:149, August 2, 1941.

17. SPINK, W. W.: Sulfanilamide and Related Compounds in General Practice. Chicago: Year Book Publishers, 1942, chaps. X, XI and XIII.

18. GOODMAN, L. G., and GILMAN, ALFRED: Pharmacological Basis of Therapeutics. New York: Macmillan Company, 1941, chaps. 56 to 59.

19. NEVIN, M. I.: *D. Items Int.*, 63:537, June 1941.

20. JANEWAY, C. A.: *J.A.M.A.*, 116:941, March 8, 1941.

21. FLEMING, ALEXANDER: *Proc. Roy. Soc. Med.* (Sect. Odontol.), 33:127, January 1940.

22. MACLEOD, C. M.: *J. Exper. Med.*, 72: 217, September 1941.

23. TSUCHIYA, H. M., *et al.: Proc. Soc. Exper. Biol. & Med.*, 50:262, June 1942.

24. HOLDER, H. G., and MACKAY, E. M.: *Mil. Surgeon*, 90:590, May 1942.

25. OSTRANDER, F. D., and HARTMAN, F. W.: Local Use of Sulfonamides. J.A.D.A., 29:1051, June 1942.

26. STERN, LEO: *J. D. Res.*, 20:143, April 1941.

27. WEINER, L.: *Mil. Surgeon*, 90:157, February 1942.

28. GREISS, FERDINAND: *J. D. Res.*, 21:3, February 1942.

29. MEACHAM, P. L., and OSGOOD, E. E.: Efficacy of Local Use of Sulfathiazole Powder in Dentistry and Oral Surgery. J.A.D.A., 28:1640, October 1941.

30. JENSEN, N. K.; JOHNSRUD, L. W., and NELSON, M. C.: *Surgery*, 6:1, July 1939.

31. HAWKING, F.: *Brit. M. J.*, 1:263, February 22, 1941.

32. COLEBROOK, L., and FRANCIS, A. E.: *Lancet*, 1:271, March 1941.

33. GOODSELL, J. O.: *J. Michigan D. Soc.*, 23:89, April 1941.

34. CLOWARD, R. B.: *J.A.M.A.*, 118:267, January 24, 1942.

35. MOORHEAD, J. J.: *J.A.M.A.*, 118:712, February 28, 1942.

36. KEY, J. A.: *J.A.M.A.*, 117:409, August 9, 1941.

37. ADAMS, F. R.: *D. Items Int.*, 61:652, July 1939.

38. *Idem: D. Items Int.*, 62:315, April 1940.

39. *Idem: D. Items Int.*, 63:329, April 1941.

40. *Idem:* Hot Solutions of Sulfonamides. J.A.D.A., 30:58, January 1943.

41. MEWAR, S. P.: *Indian D. J.*, 15:2, April-May-June 1940.

42. KNEBELMAN, A. D.: *D. Items Int.*, 62: 716, August 1940.

43. GREENHAUT, W. M.: *New York J. Dent.*, 12:251, June 1942.

44. Medicine and War. *J.A.M.A.*, 119: 1029, July 25, 1942.

AN EVALUATION OF THE SULFA DRUG AND OTHER DRESSINGS IN "DRY SOCKET" IN LOWER THIRD MOLARS

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THE postoperative occurrence of pain in the sockets of teeth is in a measure unpredictable. The type of pain to which we refer usually occurs on the third to the fifth day after operation and lasts on an average from ten days to two weeks. Associated with this pain are the clinical symptoms of failure of the clot to organize: foul odor and delayed healing. This condition is commonly spoken of as "dry socket."

This study was undertaken to note the incidence of dry socket following removal of impacted lower third molar teeth; also to note the incidence of "dry socket" when various dressings and medicaments are employed after the removal of impacted lower third molar teeth.

Only the sockets of lower third molars were considered in our study. These formed a series the members of which were similar in virtually all respects. The surgical technic as well as the type of dressing employed and the care of the socket following removal of the teeth was the same in all cases. There was need for retraction of the mucoperiosteum in all instances, and, in most of the cases, buccal bone was removed and teeth were sectioned.

We are of the opinion that the conditions favoring development of a dry socket are present before a tooth is removed. We also believe that dry socket is more likely to follow removal of teeth from the lower molar region than from other regions. This statement is based on the occurrence of three dry sockets in the region of the first molar tooth, following the normal extraction of 961 teeth.[1]

Location and related conditions probably influence this occurrence more than anything else. Self-cleansing, as well as artificial methods of cleansing in this region, is rather inefficient, and, as a result, food débris collects, an excellent medium for growth of the organisms of the mouth unabated. As these organisms live and multiply, the surrounding soft tissues become the site of inflammation.

With the removal of a third molar or any molar tooth in this region, a large cavity is produced which is surrounded by a relatively dense bony wall. The blood vessels in this dense bony wall carry a sufficient amount of blood to supply the periodontal membrane and other surrounding structures when the tooth is in position. However, on removal of the tooth, this blood supply is usually inadequate to keep the blood clot alive. Especially at this time, then, the clot is dependent on nutrition from the surrounding bone if its organization is to proceed rapidly enough to cope with the infection which is ever present to attack the clot. In those cases in which the surrounding bone appears dense in the dental roentgenogram, as in the illustration, the evidence of poor vascularity is

From the Section on Dental Surgery, Mayo Clinic.

1. MILLHON, J. A.: Unpublished data.

recognized and the chances of dry socket following the operation are increased. The larger the socket, the larger the clot; and the blood supply must be in proportion if healing is to proceed normally. If the bony structure appears radiolucent in the dental roentgenogram, the vascularity of that region will be regarded as sufficient to keep the clot alive and the possibility of dry socket following operation is lessened. According to our use, the common term "dry socket" is synonymous with the descriptive term "alveolalgia." A suitable definition of this process is that of Schwarz.[2]

socket, which, deprived of nutrition, emerges as a "dry socket" after extraction.

We concur with those investigators who are of the opinion that the clinical symptoms of a dry socket are failure of the clot to organize, accompanied by foul odor. Associated with this is pain of varying intensity usually lasting from ten days to two weeks; also, delayed healing.

In an endeavor to reduce the incidence of dry sockets, the use of various dressings and medicaments in sockets after removal of a tooth has found favor. While this practice is frowned on by some, we feel that it is a rational form

INCIDENCE OF DRY SOCKET AFTER REMOVAL OF IMPACTED LOWER THIRD MOLAR TEETH, ACCORDING TO AGE, FOLLOWING USE OF VARIOUS DRUGS, WITH A CONTROL

Age Years	Control			Medicated and Unmedicated Gauze Dressing			Sterile Petrolatum			60% Sulfathiazole in Petrolatum			60% Sulfathiazole in Glycerin Base		
	Total Extractions	Dry Socket		Total Extractions	Dry Socket		Total Extractions	Dry Socket		Total Extractions	Dry Socket		Total Extractions	Dry Socket	
		Number	Per Cent		Number	Per Cent		Number	Per Cent		Number	Per Cent		Number	Per Cent
Less than 20	29	3	10.3	6	0		26	2	7.7	24	0	–	49	0	–
20 - 29	171	23	13.5	66	0	–	122	13	10.7	144	10	6.9	223	6	2.7
30 - 39	72	19	26.4	46	2	4.3	55	4	7.3	30	1	3.3	81	4	4.9
40 - 49	18	4	22.2	20	3	15.0	23	1	4.3	15	1	6.7	34	1	2.9
50 - 59	12	1	8.3	9	0	–	8	0	–	9	1	11.1	5	0	–
60 - 69	2	1	50.0	2	0	–	3	0	–	0	0	–	5	0	–
Total	304	51	16.8	149	5	3.4	237	20	8.4	222	13	5.9	397	11	2.8

In my understanding, the "dry socket" should be defined in medical terms as a local necrotic condition of the alveolar process or its septum which, in the absence of blood vessels, can proliferate neither capillaries nor granulation tissue for the organization of the blood clot, and consequent healing. As the blood clot does not organize, it disintegrates until healthy osseous tissue is reached, then healing commences. Such a necrotic condition of a tooth socket may arise from any chronic inflammation of the pericementum and periosteum of a given

of postoperative care. The other approach is to leave the socket alone and, if dry socket does develop, treat it as such.

As we have previously pointed out, the larger the clot, the greater the demand for nutrition from the blood supply of the surrounding bone if the vitality of the clot is to be maintained so that healing may progress. With this in mind, it seems reasonable to expect that if the size of the clot in a socket is reduced by the use of some type of dressing in the cavity, the nutritive requirement from

2. SCHWARZ, H. J.: The Question of the Dry Socket. J.A.D.A., 20:1502, August 1933.

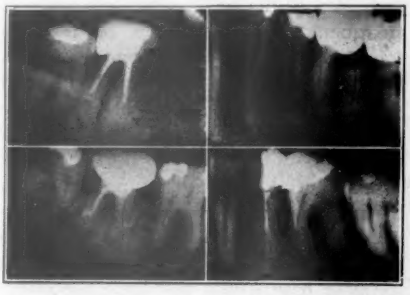
the blood in surrounding bone is such that it can be met adequately. In other words, a more even balance is established between the blood furnished by surrounding bone and the blood needed for maintenance of the vitality of the clot.

A dressing of any type placed in a socket should occupy the central portion of the socket and the top surface of the wound, the parts most susceptible to infection. Gauze dressings are effective. Those dressings that we used were one-half inch (1.3 cm.) wide.

A gauze dressing should be left undisturbed for several days. The practice of changing any type of dressing every day is to be discouraged. Each time a dressing is removed, healing is interfered with, and application of the new dressing increases the possibility of introducing new organisms into the extraction wound. In using a gauze dressing, we find that the best results are obtained when the dressing is undisturbed for from four to six days after the operation.

As to dressings of this type, we have used plain iodoform gauze, iodoform gauze impregnated with sterile petrolatum, a plain gauze dressing and a gauze dressing impregnated with sterile petrolatum. There is no evident difference in postoperative results except that, on removal of a dry gauze dressing, there is usually severe pain, especially when all of the dressing is removed at one time. For this reason, when possible, a small amount is removed each day for two or three days. Gauze dressings impregnated with sterile petrolatum are satisfactory and their removal is not nearly so painful as that of dry gauze dressings. Yet, because of the lubricant properties of the petrolatum, they sometimes tend to become dislodged and the barrier between the clot in the socket and the bacteria of the oral flora is broken down. But when organization of the clot is given a chance to progress unhindered until it is better able to cope with the infection of the mouth after the dressing is removed, the chances of occurrence of a dry socket are greatly reduced.

The practice of using sterile petrolatum in extraction wounds is not new. However, because of its lubricant quality, retention of petrolatum in open socket wounds is difficult; yet, when the mucoperiosteum can be sutured over the socket, as in impaction of lower third molar teeth, the petrolatum can be retained very satisfactorily. If the petrolatum comes in contact with the incised edges of the wound, as it generally does, healing together is prevented. This is to be desired, for as healing progresses in the socket, the petrolatum is freed from the wound. Rarely is petrolatum retained in the socket. The fact that tissue fluids are not capable of absorbing petrolatum does detract from its use in socket wounds. Other than this, there are no objections to its use.



Dense structure of bone around roots of teeth. The vascularity of bone of this type is usually not sufficient to keep the clot alive once the teeth are removed.

Besides using sterile petrolatum alone in socket wounds, we have used it as a vehicle for 60 per cent sulfathiazole.

A considerable amount of clinical work has been done with the various sulfonamide drugs, especially in their application to the tooth socket after operation. The results have been somewhat confusing, both favorable and unfavorable results having been recorded.

In a personal communication, A. E.

Brown states that "because of its polyvalent bacteriostatic effect, sulfathiazole, it would seem, is the drug of choice of the sulfonamide group as being most effective against organisms of the oral cavity; the ability of most individuals to tolerate the drug favoring its use, too."

The 60 per cent sulfathiazole incorporated in a sterile petrolatum base was applied to the extraction wounds in the same manner as sterile petrolatum used alone. However, the unfavorable factors in the employment of sterile petrolatum are also present when sulfathiazole is incorporated in it.

While our results did favor this type of socket dressing over sterile petrolatum alone, we feel that this manner of application of sulfathiazole does not give a true idea of the value of sulfathiazole in treatment of socket wounds, for the reason that, sulfathiazole being crystalline, the petrolatum acts to coat it, and petrolatum being nonabsorbable, its use limits the effectiveness of the sulfathiazole.

The initial need in a fair evaluation of the efficiency of sulfathiazole in preventing dry socket was a base that is absorbable, for two reasons: 1. An absorbable base would not limit the effectiveness of the sulfathiazole. 2. There would be no chance for retention of such a base in the socket wound.

With this in mind, several trial materials were used in the lower third molar sockets after operation. Results from the use of 5 per cent and of 20 per cent sulfathiazole in a water-soluble base were unsatisfactory and it was soon discontinued. Because 60 per cent sulfathiazole in petrolatum had proved quite satisfactory, we again attempted to use this concentration of sulfathiazole, except that a glycerin base was employed in place of the petrolatum. Later, metaphen 1:5,000 and benzyl alcohol were added.

This material seemingly possesses most of the qualities that we require. Its putty-like consistency permits it to shape itself to the socket when placed in the cavity. Apparently, it retains its form a desirable length of time when enclosed in the socket, with the result that the size of the clot is reduced and the sulfathiazole acts to inhibit the action of the oral flora in the socket wound.

One of its greatest advantages, from our standpoint, is the fact that this material can be enclosed in the socket wound, since both the drug and the vehicle are capable of being absorbed by tissue fluids.

MATERIAL STUDIED AND RESULTS

Our series consisted of 1,052 patients from whom impacted lower third molar teeth were removed. Of these patients, 795 had one impacted lower third molar tooth removed and 257 had both of the impacted lower third molars removed. All in all, there were 1,309 impacted lower third molars removed.

The incidence of dry socket in these cases, according to age of patients and following the use of sterile petrolatum, various gauze dressings, medicated and unmedicated, 60 per cent sulfathiazole incorporated in a sterile petrolatum base and 60 per cent sulfathiazole in a glycerin base, is shown in the accompanying table. Also included is a control group.

By comparison between the control series and the four other series, it can be seen readily, from the totals, that the incidence of dry socket favored the use of the 60 per cent sulfathiazole in a glycerin base and the various types of gauze dressings in the sockets after operation.

In the control series, fifty-one cases of dry socket (16.8 per cent) followed the removal of 304 impacted lower third molars.

When sterile petrolatum was used, twenty cases of dry socket (8.4 per cent) followed the removal of 237 impacted lower third molars. The incidence of

dry socket was decreased a half as compared with that in the control series.

When the various gauze dressings were used, five cases of dry socket (3.4 per cent) followed the removal of 149 impacted lower third molars.

In the series of 222 impacted lower third molars in which 60 per cent sulfathiazole incorporated in a base of sterile petrolatum was used, thirteen cases of dry socket (5.9 per cent) occurred.

In the final series, in which 60 per cent sulfathiazole was incorporated in a glycerin base, eleven cases of dry socket (2.8 per cent) followed the removal of 397 impacted lower third molars. This was the lowest percentage of dry sockets in the whole series.

Most interesting to us was the apparent relation of age to the incidence of dry socket. A consideration of the control series appears to indicate this fact. The variability of the percentages of the various age groups as they appear in the table may be due to the paucity of data. However, to make the point clearer, we divided the control series into two groups: those less than 30 years of age and those 30 years of age and older. We obtained for the two incidences 13.0 per cent and 24.0 per cent, respectively.

Because the various drugs and dressings had a favorable effect in reducing the incidence of dry socket, it was to be expected that the effect of age would be eliminated in the other series. To confirm this, a larger series is, we believe, required.

Eighty-seven per cent of the operations were performed for patients less than 40 years of age and the majority of these operations were performed for patients aged 20 to 29 years, inclusive. Among patients aged 20 to 29 years, the series in which the various types of gauze dressing were used showed the most beneficial results, in that no dry socket followed the removal of sixty-six impacted lower third molars. Also, in this group of patients aged 20 to 29 years, it will be noted that in the series in which 60 per cent sulfathiazole incorporated in a sterile petrolatum base was used, the incidence of dry socket was reduced to about half that of the control group. In the series in which sterile petrolatum alone was used, the rate was reduced to only about three-fourths that of the control group. In the series in which the 60 per cent sulfathiazole in a glycerin base was used, the rate was reduced to about one-fifth that of the control group.

Among patients aged 30 to 39 years, inclusive, all four series show an effective result, the various gauze dressings, the 60 per cent sulfathiazole incorporated in sterile petrolatum and the 60 per cent sulfathiazole incorporated in glycerin again being favored over the sterile petrolatum.

The remaining rates that appear in the table are not stable enough to permit sound interpretation.

COMMENT

Progressive healing of a socket wound beginning with organization of the original clot and ending with formation of bone in the space previously occupied by the tooth is to be desired on the removal of any tooth. Yet, if conditions that interfere with progressive healing are predominant, dry socket will be the result. When there is a delay in the initial formation of bone, we find that the original clot has failed to organize.

In a series of 961 normal extractions throughout the mouth, we found three cases of dry socket, all in the lower molar region. Also, fifty-one cases of dry socket followed the removal of 304 impacted lower third molars in which no dressings were used. Especially from the former series, it is evident that so-called dry socket is more apt to occur in the lower molar region.

The statement is often made that "dressings promote healing." This may

be true, but with some qualifications. We feel that dressings promote healing only because they are an added protection to the vulnerable clot, and this added protection allows organization of the clot to progress without interference from organisms in the mouth. More important is the fact that dressings when placed in a socket displace blood from the central portion of that socket. This reduces the size of the clot, and the nourishment, or blood supply, from the surrounding bone can in most instances better maintain the vitality of a small clot. This is demonstrated by the effectiveness with which various types of dressings in the sockets act to decrease the incidence of dry socket in these cases as compared with those cases in which no dressings were used. While it has been possible to show a very low incidence of dry socket in those cases in which sulfathiazole in a glycerin base was used in the lower third molar sockets, we are of the opinion that the sulfathiazole alone does not prevent dry socket. Of equal importance is the mechanical action of this dressing in reducing the size of the clot when blood is displaced from the central portion of the socket. This small blood clot needs less time to organize than a larger clot requires. With this in mind, it cannot be emphasized too strongly that we cannot avoid by the use of the sulfonamides, those disagreeable results that would be expected to follow a careless surgical technic.

We have not found sulfathiazole of value in the treatment of dry socket, once symptoms have developed.

After the removal of cysts from the jaws, we have used only sulfathiazole powder, and rather sparingly. When used in such quantities as would be necessary in a cavity produced by removal of a cyst, it often is poorly absorbed and has a tendency to cake, thus becoming a foreign body, healing failing to progress normally until the material is removed. In these conditions, we commonly make use of an atomizer to insufflate the cyst cavity with a small amount of sulfathiazole powder. One of the gauze dressings is then placed fairly loosely in the cyst cavity, being removed later as described in a previous paragraph.

In a complete upper or lower alveolectomy, or extraction of impacted upper teeth, we prefer sulfathiazole in powder form, blown, by means of an atomizer, over the exposed bone and under the mucoperiosteum that has been retracted. This is done just before the soft tissues are approximated and sutured. While no comparative results can be presented, we feel that our results favor this procedure.

Sulfathiazole, when placed in an open socket wound, can be kept in position by a small moist gauze sponge placed over the socket wound and by pressure exerted by the patient in biting down on the gauze sponge fifteen or twenty minutes before it is removed.

F. A. Willius, consultant in the Section on Cardiology, has said:

> Experience has shown that patients with healed rheumatic valvular lesions and congenital cardiac defects are candidates for subacute bacterial endocarditis. A subacute bacterial endocarditis has followed dental extraction with sufficient frequency to call for the institution of measures designed to minimize or avert this complication. Therefore, the use of the sulfonamides for one or two days preceding and following dental extraction is recommended. At the time of extraction, one of the sulfonamide drugs is placed in the socket.

This may not be the entire answer to prevention of subacute bacterial endocarditis after extraction of teeth, but it is one of those measures that we can and should use.

PHYSICAL PROPERTIES OF DENTURE RESINS: PART I. CURING SHRINKAGE AND WATER SORPTION

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THE subject of dimensional stability of dental resins is of much greater importance in its dental uses than in most industrial applications. The matter has, of course, become of even greater importance since the resins have been used to restore lost tooth structure. There are at least two recognized dimensional changes which are unavoidably active in every acrylic denture; namely, shrinkage, which occurs during processing and, subsequently, expansion, which occurs upon immersion in water. The classic publication of Sweeney, Paffenbarger and Beall[1] concerning the magnitude of these changes is well known. As pertinent to the present study, they found that (1) the processing shrinkage varied to some extent between the various denture resins studied and (2) the increase in dimension after soaking in water was usually greater than the curing shrinkage, particularly in the case of the methyl methacrylate resins. It should be noted, however, that the percentage increase in size after water sorption was not measured on the specimens that were employed in determining the curing shrinkage. Peyton and Mann[2] found the increase in size of the resin during water sorption to be identical in value with the processing shrinkage. In the light of such varying data, it was thought best to repeat the work and, at the same time, investigate certain other variables not yet considered.

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METHODS OF MOLDING

Two generally recognized methods of molding acrylic resins have been employed in dentistry: compression molding and injection molding. The compression molding process is the usual method employed for the processing of dentures in flasks, under heat and pressure. In the present research, Hanau flasks were employed with a spring clamp. A slight excess of resin was left in the mold, and the final closure was accomplished under maximum pressure.[3]

Injection molding is accomplished by means of special equipment, one type of which is shown in Figure 1. Since the details of this process have been explained elsewhere,[4] it need be described only briefly. A special type of flask is required. The cast with the wax baseplate is invested as usual, but some type of an ingate must be provided through which the resin is forced or injected into the mold while in a plastic condition. Since the resin is kept under pressure in the ingate throughout the processing, it is reasoned that the shrinkage is thus compensated by forcing in excess resin.[4] According to some authorities,[5, 6] the injection molding of dentures causes excessive processing strains, which are apt

to cause warpage during service as the strains are relieved.

GENERAL PROCEDURE

The resins were processed against metal models throughout the study in order to eliminate any variables contingent upon the stability of a stone cast. At the start of the investigation, a metal model of an edentulous upper arch was used, but this was later discarded in favor of an experimental model designed for convenience in measurement, which represented diagrammatically a posterior section of an upper edentulous mouth. Two views of the experimental model

Fig. 1.—Dental injection molding equipment.

are shown in Figure 2. Careful check measurements demonstrated that the dimensional changes incurred with specimens from the experimental model were identical within the limits of error with those for the dental model.

The metal model was invested in the lower half of the flask as usual. The thickness of the mold space was made uniformly equivalent to two thicknesses of baseplate wax. The upper half of the mold was tinfoiled, either before or after the upper half was flasked.

The directions of the manufacturer were generally followed in the packing of the mold, although employment of a slight excess of resin was thought to be better than to run the risk of insufficient bulk. The manufacturer's directions were also followed for the testing, method, time and temperature of processing. The compression molding method was used as well as both the Pryor and luxene injection molding methods on all resins studied. Since the results of the two injection methods were identical, no distinction has been made in subsequent discussions.

After processing, the flasks were cooled at two different rates. In the method hereafter designated as "fast cooling," the specimen was cooled in the flask under pressure for from twenty to thirty minutes in running water at a temperature of approximately 20° C. (68° F.). "Slow cooling" means that the flask was either bench-cooled for three or four hours, or allowed to cool in the water bath overnight from 100° C. (212° F.).

Five commercial denture resins were studied as listed in Table 1. All of the resins were furnished gratis from stock by the respective manufacturers. With the exception of luxene 44, all of the products are basically methyl methacrylate resins. Luxene 44 is supplied in the form of a plastic cake or dough, which is essentially an 80-20 vinyl chloride-acetate copolymer resin plasticized with methyl methacrylate monomer. The polymerized material may therefore be termed a vinyl copolymer acrylic resin. Unless otherwise designated, all resins were untinted and used in the powder-liquid form with the exception of luxene 44.

CURING SHRINKAGE

The curing shrinkage was determined as the linear percentage difference between the gage marks on the original

model (Fig. 2, b) and their impression in the fully polymerized specimen. The shrinkage values so obtained (Table 2) are the average of three or more trials. The average deviation for all of the measurements was ±0.03 per cent.

In general, luxene 44 exhibited the least curing shrinkage, although some of the values for densene are equally low. The shrinkages obtained on fast cooling after processing are generally less than those obtained by cooling slowly, luxene 44 being an exception. There is no significant difference in shrinkage for corresponding rates of cooling whether the specimens were molded by injection or by compression.

WATER SORPTION

All specimens were allowed to remain in water at 37° C. (99° F.) for at least three weeks before measurement. It was shown by experiment that immersion in water for more than three weeks was not necessary, since any further changes were so slight as not to be of practical interest. The percentage differences between the gage-mark distances on the specimen before and after immersion, as compared with the distance between the gage marks on the original model, are presented in Table 3. These data presumably represent the amount of swelling of a denture in water over a period of three weeks.

All of the resins increased in bulk during this test, some of them more than others. In general, the specimens that were cooled fast after processing expanded less than did those cooled slowly. When the rate of cooling is the same, there is no apparent difference in the expansion as far as the method of molding is concerned.

NET CHANGE

There is no doubt that the acrylic denture is smaller than the original pattern owing to shrinkage during curing, as shown in Table 2, but if the denture expands when immersed in water or saliva, part of this shrinkage may be compensated. The final dimensions (or net change) of the resin specimens under observation can be calculated by subtracting the shrinkage data in Table 2 from the corresponding figures for the expansion in water as given in Table 3. If the result is negative (−), the expansion in water has not compensated for the curing shrinkage by the amount shown and the specimen is smaller than the original. If the result is positive (+), the shrinkage has been overcompensated and the specimen is larger than the original. The results so calculated are shown in Table 4.

According to Table 4, it must be concluded that the expansion in water very nearly compensates for the curing shrinkage in every case, many of the differences

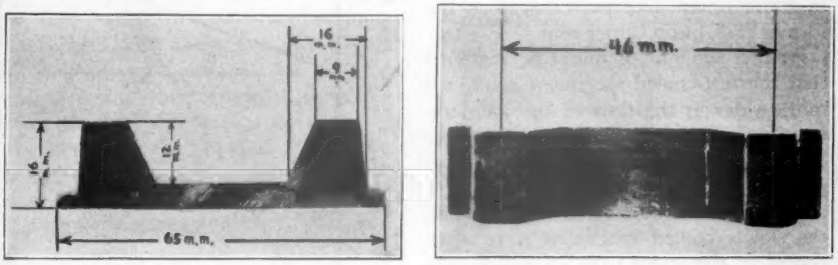

Fig. 2.—Special brass model employed for studying dimensional changes of denture resins: (a) side view; (b) top view.

being within the limits of experimental error, and none of them of practical significance. This conclusion is in agreement with Peyton,[2] but it is in disagreement with the similar work of Sweeney *et al.*[1]

It is further apparent that the amount of the net change is independent of both the method of molding and that of cooling after processing. The latter observation is of particular interest, since it is not expected that the amount of expansion in water should be dependent on the difference in curing shrinkage for a given resin. For example, lucitone, when cooled fast after a compression molding, shrinks 0.36 per cent (Table 2) and expands 0.38 per cent in water (Table 3). The same material, when cooled slowly, shrinks 0.50 per cent, but its expansion in water is not 0.38 per cent, as in the former case, but 0.54 per cent.

At first thought, it might be reasoned that the fast-cooled specimens contained more water at the time of the measurement for curing shrinkage, and therefore less imbibition occurred during the storage period in water. Although this explanation did not seem tenable since the slowly cooled specimens were often cooled in the water bath overnight with no difference in results from bench-cooling, the following experiment was carried out:

Four specimens of lucitone were processed with compression molding in the usual manner. At the end of the curing period, the flasks and clamp were immediately buried in carbon-dioxide ice, with the idea that all water in contact with the resin at this stage would be frozen before imbibition could take place. After one hour, the flasks were quickly removed from the ice, opened and allowed to thaw out in a desiccator containing calcium chloride. The average shrinkage was 0.19 per cent, which is approximately one-half the normal value. (Table 2.) It appears, therefore, that the rate of cooling of the resin specimens after processing had a definite effect upon the observed shrinkage.

A THEORY OF CURING SHRINKAGE

Sweeney *et al.* have presented a rationale for the observed curing shrinkage values, and the discussion which follows is based upon their presentation.

The values for curing shrinkage given in Table 2 are not the actual amount of shrinkage of the resin from the curing

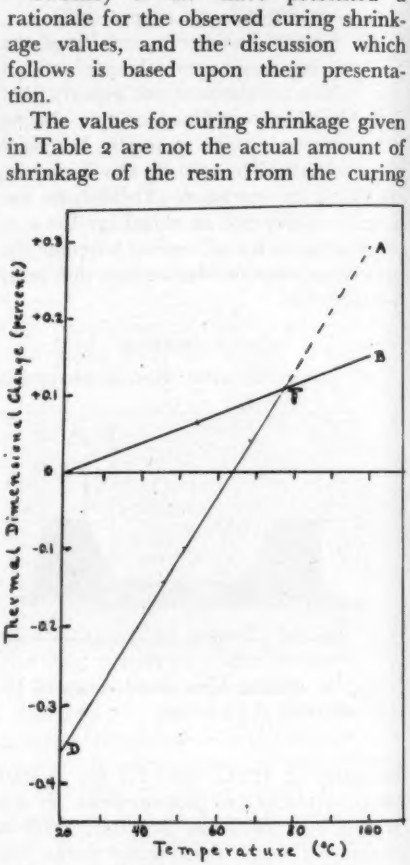

Fig. 3.—Thermal contraction curves for lucitone (DA) cooled rapidly after compression molding, and for brass model (OB). The transition temperature is 78° C. (172° F.) as shown by the intersection of the two lines at T.

temperature to that of the room, but rather represent the percentage difference in size between the specimen and the brass model at room temperature (25° C.).

During the polymerization stage of the processing, a reaction shrinkage occurs, but this is possibly compensated by the excess resin present in the mold, the relief of strains in the investing medium[3] and other like factors. It is at this stage, while the plasticity of the resin is relatively great, that the injection molding process is theoretically superior to compression molding, since additional resin supposedly can be forced into the mold to counteract the reaction shrinkage. This conclusion is not entirely warranted on the basis of the data in Table 2. It should be noted further that we are discussing only the fit of the resin on the bearing surface of the model, and that any anomalous shrinkage in other parts of the specimen is neglected. On the basis of such reasoning, it is assumed that any shrinkage that occurs before the cooling of the case is not of practical importance, and need not be considered as part of the observed shrinkage.

The resin, when it begins to cool, obviously begins to contract thermally, but so does the metal model. The mutual effect of the two thermal contractions may be studied graphically as shown in Figure 3. Although lucitone was chosen for this study, any one of the other materials (except luxene 44) might have been used. There are, of course, two known data for use in plotting the curves: (1) the difference between the thermal shrinkage of the specimen and model as given in Table 2 and (2) the curing temperatures. In Figure 3, it is assumed that the "zero" value is the dimension of the brass model at room temperature. By using the accepted value for the linear thermal coefficient of expansion of brass (0.000019 per degree centigrade), the thermal expansion or contraction curve (OB) for the model can be plotted.

If the linear thermal coefficient of expansion for the resin is assumed to be 0.000081 per degree centigrade,[7] the thermal expansion curve (DA) for the resin can be plotted, with a fiducial value of -0.36 per cent, which represents the observed shrinkage (Table 2). It may be noted (Fig. 3) that the two straight lines intersect at the point T, which corresponds to a temperature of 78° C. (172° F.). According to this graph, the theory of the thermal contraction is that, at temperatures above 78° C. (or T), lucitone is sufficiently plastic to remain adapted to the model under pressure as the model contracts. In other words, it contracts thermally with the model and not along its own contraction curve (AT) (Fig. 3). Since such a forced contraction involves distortion, it can be postulated that considerable processing strains are induced during this period.

TABLE 1.—MATERIALS INVESTIGATED

Trade Name	Manufacturer or Distributor
Crystolex	Kerr Dental Mfg. Co., Detroit, Mich.
Densene	Cosmos Dental Products, Inc., New York, N. Y.
Lucitone	The L. D. Caulk Co., Milford, Del.
Luxene 44	Luxene, Inc., New York, N. Y.
Vernonite	Vernon-Benshoff Co., Pittsburgh, Pa.

When the resin cools to temperature T (78° C., Fig. 3), it assumes sufficient rigidity to contract independently of the model as given by the line TD (Fig. 3). Some of the strains introduced during this period will be relieved by the elastic recovery of the specimen immediately after deflasking. The temperature T, then, may be considered a boundary temperature between rigidity and plasticity of the resin as controlled thermally, and it can be termed the transition temperature. Undoubtedly, the linear thermal coefficients for the various resins differ one from another, but if the accepted value of 0.000081 per degree centigrade is used, computation of the transition temperatures for the different resins re-

sults in values generally within the limits of the published softening temperatures for these resins.[8]

(The computations are best obtained from the following algebraic equation: 100 [(R-M) (x-t)]=s, where x= transition temperature in degrees centigrade. R=linear thermal coefficient for the resin per degree centigrade. M= linear thermal coefficient for the model or cast per degree centigrade. t=temperature to which the resin was cooled. s=observed shrinkage [Table 2]).

The theory requires that the transition temperature of lucitone, for example, be higher when the resin is cooled fast after processing than when it is cooled slowly. This apparent anomaly can be explained by the high thermal conductivity of the metal model in comparison with that of the investing plaster. When the flask is cooled rapidly, the metal conducts the heat from the resin in contact with it, and in effect produces a higher transition temperature. On this basis, the curing shrinkage and degree of processing strain with a stone model will be different from that obtained with a metal model; the stone cast should show less difference in shrinkage as affected by the rate of cooling, and the transition temperature should be higher because of the lower thermal conductivity of the gypsum material. Research on the influence of the

TABLE 2.—LINEAR CURING SHRINKAGE

Trade Brand	Compression Molded		Injection Molded	
	Slowly Cooled (Per Cent)	Fast Cooled (Per Cent)	Slowly Cooled (Per Cent)	Fast Cooled (Per Cent)
Crystolex	0.35	0.28	0.31	0.23
Densene	0.33	0.23	0.35	0.27
Lucitone	0.50	0.36	0.51	0.31
Luxene 44	0.28	0.22	0.26	0.26
Vernonite	0.39	0.34	0.42	0.30

TABLE 3.—LINEAR EXPANSION AFTER STORAGE IN WATER AT 37° C.

Trade Brand	Compression Molded		Injection Molded	
	Slowly Cooled (Per Cent)	Fast Cooled (Per Cent)	Slowly Cooled (Per Cent)	Fast Cooled (Per Cent)
Crystolex	0.36	0.26	0.37	0.28
Densene	0.36	0.19	0.36	0.24
Lucitone	0.54	0.38	0.55	0.36
Luxene 44	0.23	0.26	0.24	0.22
Vernonite	0.46	0.33	0.54	0.28

TABLE 4.—NET CHANGE

Trade Brand	Compression Molded		Injection Molded	
	Slowly Cooled (Per Cent)	Fast Cooled (Per Cent)	Slowly Cooled (Per Cent)	Fast Cooled (Per Cent)
Crystolex	+0.01	−0.02	+0.06	+0.05
Densene	+0.03	−0.04	+0.01	−0.03
Lucitone	+0.04	+0.02	+0.04	+0.05
Luxene 44	−0.05	+0.04	−0.02	−0.04
Vernonite	+0.07	−0.01	+0.12	−0.02

cast material is being carried on in this laboratory at the present time.

The processing strains will be relieved only by time, or a temperature rise to the region of the transition temperature. In other words, the strains may be said to be "locked" at temperatures below the transition temperature. It is on this basis that the difference in water sorption of the slowly and fast cooled specimens processed against metal can be explained. These experiments will be made the basis for a future publication.

Table 5.—Comparison of the Plastic Cake and Powder-Liquid Forms of Two Denture Resins

	Vernonite				Lucitone			
	Compression		Injection		Compression		Injection*	
	P.-L. (Per Cent)	Cake (Per Cent)	P.-L. (Per Cent)	Cake (Per Cent)	P.-L. (Per Cent)	Cake (Per Cent)	P.-L. (Per Cent)	Cake (Per Cent)
Shrinkage	0.39	0.26	0.42	0.31	0.44	0.45	0.31	0.30
Water sorption	0.46	0.48	0.54	0.45	0.53	0.53	0.36	0.38
Net change	+0.07	+0.22	+0.12	+0.14	+0.09	+0.08	+0.05	+0.08

*Fast cooled.

POWDER-LIQUID VS. PLASTIC CAKE

There has been in the past considerable discussion as to the method of dispensing resin to the dentist. Some manufacturers prefer to distribute it with the polymer in the form of a powder and the monomer in separate containers, to be mixed by the dentist just before packing the mold. Other manufacturers would rather mix the monomer and polymer as part of the manufacturing process, and supply to the dentist the plastic cake or dough ready to be packed in the mold.

The powder-liquid form has long been the favorite of the dental profession. It undoubtedly offers the greater latitude of manipulation, but, in all fairness, the arguments in favor of the plastic cake should also be presented. For example, it is well known that improper mixing of the monomer and polymer may result in porosity of the finished denture.[1] It is a self-evident fact that better control in mixing can be obtained by the manufacturer in large batches under standard conditions than by a dentist with individual units. Such control may obviate many troubles from a service standpoint. In our hands, the plastic cake form was greatly preferred. It saved the time of mixing, and it appeared to "work" better, with greater uniformity of plasticity and color.

One of the chief disadvantages of the plastic cake form is its limited shelf life,[9] due to the fact that it gradually loses its plasticity when stored at room temperature. It can be stored safely for several months in a refrigerator, however. Acting on a suggestion by H. M. Vernon, we have stored it successfully for an indefinite period at room temperature in the presence of methyl methacrylate vapor in a desiccator.

Table 6.—Impact Strength of Three Denture Resins

Trade Name	Impact Strength (Cm.-Kg./Cm.^{2})
Lucitone	10
Luxene 44	23
Vernonite	13

Two denture resins have been compared as to their dimensional stability in the powder-liquid and plastic cake forms, according to Table 5. With the exception of the lucitone injected specimens, all data were obtained after slow cooling

of the resin from the curing temperature. There is apparently no difference in the curing shrinkage between the methods of molding the two forms, and with the exception of vernonite (compression molded), there is little or no difference in the dimensional changes as to whether the plastic cake or powder-liquid form of the resin was employed.

IMPACT STRENGTH

Bars of standard size,[10] 2.5 by 10 by 65 mm., were milled from three of the resins. After soaking in water at 37° C. for three weeks, they were tested for impact strength at room temperature by the Charpy method, under a 10 cm.-kg. hammer with a span of 32 mm. The average values for the impact strength from five specimens for each material are given in Table 6.

The property of impact has little clinical significance aside from possibly being a measure of resistance to accidental shock by dropping, etc. Luxene 44 apparently possesses about twice the impact strength of the two methyl methacrylate resins.

SUMMARY AND CONCLUSIONS

Five commercial denture base materials have been studied as to their dimensional stability as affected by (1) the method of processing, (2) the rate of cooling after processing and (3) subsequent immersion in water.

The results and conclusions may be summarized as follows:

1. As far as curing shrinkage and water sorption were concerned, no difference was observed between the injection and compression molding procedures.

2. When the resin is processed against metal models, the curing shrinkage is less if the resin is cooled rapidly from the processing temperature.

3. A theory for the curing shrinkage is presented on the assumption that it is entirely thermal in nature, and, for a given resin composition, it will depend upon the temperature at which the resin becomes sufficiently rigid to contract thermally independently of the cast or model. The temperature at which such rigidity is attained has been termed the transition temperature.

4. The imbibition of the resin in water generally compensates for the shrinkage that occurs during processing. This is accounted for by the fact that the increase in size is limited by the processing strains incurred above the transition temperature.

5. There is little difference between the powder-liquid and plastic cake forms of the resin as far as dimensional changes occurring during and after processing are concerned.

6. Two of the methyl methacrylate resins exhibited lower impact strength than did the vinyl copolymer acrylic resin.

BIBLIOGRAPHY

1. SWEENEY, W. T.; PAFFENBARGER, G. C., and BEALL, J. R.: Acrylic Resins for Dentures. J.A.D.A., 29:7-33, January 1942.

2. PEYTON, F. A., and MANN, W. R.: Acrylic and Acrylic-Styrene Resins: Properties in Relation to Uses as Restorative Materials. J.A.D.A., 29:1852, October 1942.

3. TAYLOR, P. B.: Acrylic Resins: Manipulation. J.A.D.A., 28:373-387, March 1941.

4. PRYOR, W. J.: Injection Molding of Plastics for Dentures. J.A.D.A., 29:1400-1408, August 1942.

5. TYLMAN, S. W.: Where and How May Acrylics Be Used in Restorative Dentistry? J.A.D.A., 29:640-647, April 1942.

6. SOUDER, WILMER, and PAFFENBARGER, G. C.: Physical Properties of Dental Materials. B. of S. Circ. C433, U. S. Gov't Printing Office (1942), p. 165.

7. Reference 6, p. 170.

8. Plastics Catalog (1942), p. 184.

9. SWEENEY, W. T.: Denture Base Material: Acrylic Resin. J.A.D.A., 26:1863-1873, November 1939.

10. SWEENEY, W. T., and SCHOONOVER, J. C.: Progress Report on Denture Base Material (1935). J.A.D.A., 23:1501, August 1936.

THE PROXIMAL GOLD FOIL FILLING INVOLVING THE INCISAL ANGLE

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TO those interested in gold foil, cavities in the proximal surfaces of the incisor teeth which involve the incisal angle present interesting possibilities. The chief objection to this type of filling from the patient's point of view is the display of gold. While it is conceded that the operation involving the incisal angle is necessarily extensive, it is possible, by judicious cutting, to develop the outline form so that the filling, when finished, will be far less conspicuous.

CAVITY PREPARATION

Contrary to the teachings of some operators, the proximal labial margin should be a straight line from the incisal edge to a point beneath the free margin of the gingiva parallel to the long axis of the tooth, and as close to the embrasure as is consistent with the principles of extension to areas of relative immunity. (Fig. 1, A.) If this cut is made otherwise, as, for instance, parallel with the proximal surface of the tooth, there will develop at the incisal angle an unsupported area of enamel which will prove a menace in condensation, and the finished result will be out of harmony with the tooth.

The amount of tooth structure cut from the incisal edge will depend on the type of tooth and the stresses placed upon the incisal angle. Ordinarily, the incisal cut is carried two-thirds of the way across the incisal edge (Fig. 1, B), thus securing a greater leverage for the filling, which will be anchored by an incisal retention form. A cut which is not past the middle lobe of the tooth places the retention form in a position which may embarrass the pulp.

By crossing the incisal edge labiolingually, at an angle of 45°, additional resistance to masticatory stresses from the lingual aspect is obtained. (Fig. 1, C.) This cutting can be done with a carborundum stone. The proximal lingual wall can be cut down to a point below the free margin of the gingiva with a straight chisel. (Fig. 1, D.) The proximolinguoincisal angle is well rounded off, as indicated by the dotted line in Figure 1, D.

In cutting across the incisal edge, the stone is held in such a manner that the lingual enamel plate is reduced more than the labial plate. (Fig. 2, A.) Because of the stresses upon the tooth, the shape of the tooth and the thickness of the labial and lingual enamel plates, it is not possible to state dogmatically how much of the lingual plate should be removed. Generally speaking, it is at least twice as much as the enamel removed from the labial plate. One of the methods of reducing the lingual plates is to undermine the lingual enamel with a small single cut fissure bur. (Fig. 2, B.) With the chisel, as illustrated in Figure 2, C, the enamel is cleaved away, to effect the "incisal step." Some operators reduce the lingual enamel plate with small inverted cone stones, as shown in Figure 2, D. The "incisal step" is to be

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finished smoothly with special burs, stones, chisels and cuttle disks when accessible.

The proximal portion of the cavity should be extended far enough to free contact with the adjacent tooth. The gingival seat should either be flat (Fig. 3, A) or should follow somewhat the curvature of the cervical line. An inverted cone bur is useful here provided care is taken that it is not brought too far labially or lingually. Primarily, the gingival seat must be so constructed that pulp and the dentino-enamel junction. The depth to which this bur is projected is a matter of judgment, depending on the size of the cavity and the stresses to be exerted on the filling.

The bur is also drawn up the labio-axial and linguo-axial line angles approximately a third of their length. These line angles are now emphasized and accentuated by the use of small mon-angle hoes. (Fig. 4, B.)

Probably not more than a third of the linguo-axial line angle can be used for

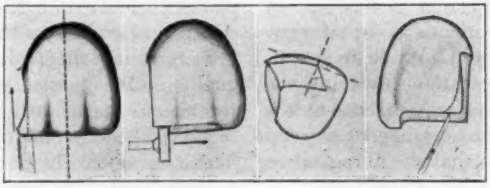


Fig. 1.—A, proximolabial margin parallel to long axis of tooth. B, incisal cut carried approximately two-thirds of way across incisal edge. C, crossing incisal edge at an angle of 45° to obtain additional resistance to masticatory stresses from the lingual aspect. D, proximo-linguo-incisal angle well rounded off.

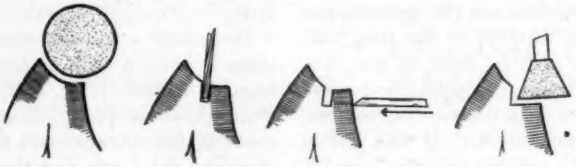


Fig. 2.—A, initial reduction of lingual enamel plate. B, undermining of lingual enamel plate. C, cleaving away of undermined enamel. D, finishing "incisal step."

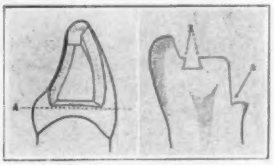
it presents a flat surface at least at right angles to the line of incisal stress.

Substantial retentive resistance form, which is necessary for this filling, is secured by means of two point angles at the gingival portion and an incisal retention form at the far end of the incisal step. The gingival point angles are started with a small single-cut fissure bur. (Fig. 4, A.) The direction of the gingival retention forms are such that they all times to be in dentin between the bisect the point angles. The bur is at retentive resistance forms, but that portion which is available must be utilized to the fullest extent.

The labio-axial line angle, while it may be generally obtuse, should be prepared in a definite manner. For example, Figure 5, A is a transverse section at the gingival seat, showing a retentive labio-axial and linguo-axial line angle which is definitely an acute angle. At the junction of the gingival third and the middle third, the labio-axial and linguo-axial line angles approximate a right

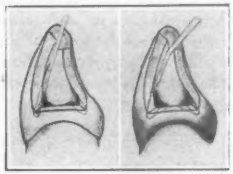
angle. (Fig. 5, B.) In the middle third (Fig. 5, C), both line angles are obtuse and, in the incisal third (Fig. 5, D), the line angle fades out, leaving as much dentin as possible to support the enamel plates.

The incisal step presents a flat ledge on the lingual aspect, which is all-important in the resistance of the filling to masticatory stress. The labial wall of this step is cut parallel with the long axis of the tooth, a triangular portion of dentin remaining to support the labial plate. Retention is further secured by cutting a rectangular form at the far end of the incisal step. Usually, this retention is made with a small single cut fissure bur slightly undercutting the mesial and distal walls as indicated by the letter X in Figure 3, B. This incisal retention form should be cut as large as is consistent with the area involved. Generally, it is made too small for the purpose for which it is intended. The incisal retention form should be directed gingivally parallel to the labio-incisal plate of enamel, keeping well within dentin and away from the lingual enamel plate. (Fig. 6.)



A B

Fig. 3.—A, gingival seat. This should be flat. B, gingivo-axial line slightly acute, as is preferable.



A B

Fig. 4.—A, gingival point angles started with small single cut fissure bur. B, line angles accentuated by means of monangle hoes.

The cavosurface angles of the cavity should be planed and disked when accessible. The gingival cavosurface is beveled with a monangle hoe. Any other part of the cavity in which there is any doubt regarding unsupported enamel is also beveled. There should never be any angles as such in the outline form to disturb the harmony of tooth outline form.

Fig. 6.—Incisal retention form directed gingivally parallel to labio-incisal plate of enamel. The completed cavity is presented in Figure 7, from various aspects in recapitulation of some of the key points of the cavity preparation.

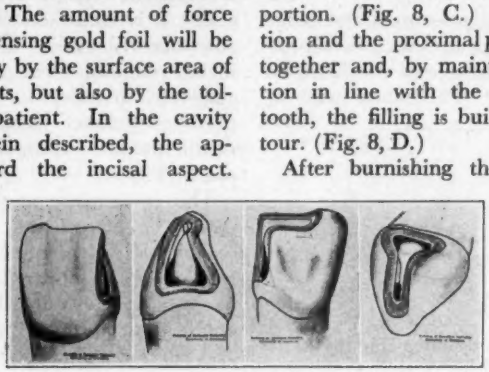
A B C D

Fig. 5.—A, labio-axial and linguo-axial line angles, which are definitely acute angles. B, line angles approximating right angle. C, line angles obtuse. D, line angles fading out.

CONDENSING AND FINISHING

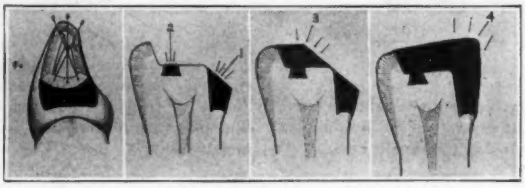
To condense gold foil properly, the

force should be in as nearly a direct line as possible to the long axis of the tooth, so that the peridental membrane may resist the pressure demanded in filling. The plugger points should be cleansed frequently and the serrations freed of gold adhesions. The amount of force applied in condensing gold foil will be governed not only by the surface area of the plugger points, but also by the tolerance of the patient. In the cavity preparation herein described, the approach is toward the incisal aspect.



A B C D

Fig. 7.—A, proximolabial aspect of finished cavity, showing proximolabial margin parallel to long axis of tooth and incisal cut carried approximately two-thirds of way across incisal edge. B, proximal aspect, illustrating "incisal step" and accentuation of labio-axial and linguo-axial angles from retention forms. C, proximolingual aspect. The proximolingual incisal angle is well rounded off. D, proximo-incisal aspect of finished cavity, showing incisal retention form and acute gingivo-axial line angle.



A B C D

Fig. 8.—Steps in condensation of proximo-incisal gold foil filling.

Regardless of the type of plugger point, the gold foil is being wedged continually between the labio-axial wall and the linguo-axial wall. (Fig. 8, A.) The foil should be stepped continually from the center of the mass of previously condensed gold foil toward one of the walls.

The gold foil is started in both of the gingival point angles, building up the axial wall at an angle of 45° (Fig. 8, B), care being taken to carry the foil out to the full contour as we proceed. If this is not done at this time, it will be difficult to go back and fill in the deficiencies later. When the filling has reached the "incisal step," the foil is started in the incisal retention form and condensed across the incisal to meet the proximal portion. (Fig. 8, C.) The incisal portion and the proximal portion are welded together and, by maintaining condensation in line with the long axis of the tooth, the filling is built up to full contour. (Fig. 8, D.)

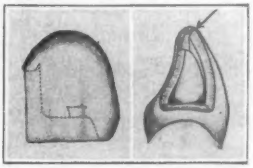
After burnishing the gold over the margins, the surplus is trimmed off with knives, chisels, files, stones, disks and strips and the filling brought to shape and contour. In the final finishing of the proximo-incisal gold foil, it is essention not only to recover the original esthetic outline created, but to restore the harmonious proportions in the varying curves and angles of the tooth.

VARIATIONS

There are other methods of treating cavities in the proximal surfaces of in-

cisors in which the incisal angle has become involved. Every operator wishes to display as little gold as is commensurate with the stresses placed upon the filling. In cases of marked overjet, it is possible to prepare cavities which do not display any gold in the incisal edge. A cavity of this type is illustrated in Figure 9, A and B.

In delicately shaped incisors with a short labiolingual diameter, the operator will experience difficulty in finding sufficient dentin between the labial and lingual plates of enamel for the incisal retention form. In this type of case, the incisal retention form is cut through the lingual enamel plate and undercuts are made in the mesial and distal wall of the incisal dovetail in dentin for retention. (Fig. 10.)



A B

Fig. 9.—A, labial aspect of mesial incisal cavity not involving labial plate at incisal edge. B, proximal aspect of same cavity.

In incisors with a short labiolingual diameter, the incisal retention form is cut through the lingual enamel plate and undercuts are made in the mesial and distal walls of the "incisal" dovetail in dentin for retention. (Fig. 10.) Another method of treating a proximal cavity which involves the incisal angle is to prepare the proximal portion in the orthodox manner, but, in place of cutting down the incisal edge for resistance, prepare a lingual dovetail for additional anchorage and resistance. (Fig. 11.) This cavity can be prepared only in teeth which have a marked labioversion. In teeth with a linguoversion, it is definitely contraindicated. This lingual dovetail should be placed as close to the incisal edge as is consistent with the bulk of the tooth structure to prevent undue leverage from damaging the incisal angle.

Fig. 10.—Incisal retention form cut through lingual enamel plate and undercuts made in mesial and distal walls of "incisal" dovetail in dentin.

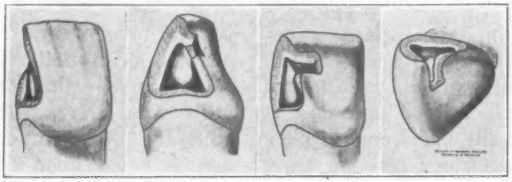


Fig. 11.—Four aspects of proximo-incisal foil cavity preparation, utilizing lingual dovetail for anchorage.

In short teeth that are thick labiolingually, it is occasionally possible to prepare a cavity involving the incisal angle without any special treatment other than establishing a bulky incisal retention form. (Fig. 12.) The involved incisal angle is slightly rounded to protect the enamel rods on the incisal edge. This preparation can be used only in those cases in which the lateral excursions of the opposing teeth do not place undue stress on the filling.

While the preparation illustrated in

Figure 12 is considered in certain cases, it has been observed that gold foil under heavy stress has a tendency to pull away from the axial wall and to open at the incisal margin.

In preparing a proximo-incisal cavity for gold foil in the lower incisors, a consideration of masticatory stress is important. In cases of overbite, both normal and abnormal, it will be necessary to remove more of the labial enamel plate than the lingual enamel plate in lower incisors. (Fig. 13.)

Fig. 12.—Proximal gold foil cavity involving incisal angle in which there has been no cutting of incisal edge or preparation of dovetail on lingual edge.

The anatomic form of a lower incisor is of such nature that frequently the linguo-axial wall need not be extended for the access desirable in an upper incisor. Likewise, in lower incisors, it is the linguo-axial line angle that is accentuated in much the same manner as the labio-axial line angle in upper incisors. In the lower incisors, the incisal retention form is placed in dentin between the labial enamel plate and the lingual enamel plate. This requires discretion, since it is very easy to involve a pulp in a lower incisor.

The cavity illustrated in Figure 13 is considered the normal cavity. It too is subject to variations depending on the form of the tooth in question and the relationship of the tooth to the adjacent and opposing teeth.

Fig. 13.—Four aspects of proximo-incisal gold foil cavity for lower incisor.

SUMMARY

In the past, the masters of the gold foil art have shrouded the proximo-incisal foil cavity preparation with a veil of complexity. In reality, the proximo-incisal foil cavity is less difficult to prepare than the strict proximal foil cavity, largely because it is readily accessible. All gold foil cavity preparation is based upon fundamental principles, which may be varied in singular cases. The condensing of gold foil into a proximo-incisal cavity is exacting, requiring skill which is acquired only by perseverance. Perfectly condensed, properly contoured gold foil fillings in a proximo-incisal cavity of harmonious proportions have no equal.

ASYMMETRY OF THE FACE

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IN the study of facial asymmetry, it must be recognized that there is no truly symmetrical face regardless of the race, age or period of the individual. The problem of normal asymmetry has been extensively investigated by preparing photographs consisting of the right and left halves of the face with their respective mirror image. The three photographs (normal face, right face and left face) appear to be three different persons (Fig. 1) rather than pictures of one individual.

The early artists were aware that this normal variation was necessary to give life and character to their paintings. A perfect face was noted to be monotonous. This is why the wax images in the display windows are so expressionless.

The normal asymmetry is not very evident, whereas the abnormal asymmetry is quite obvious. The term asymmetry, as used in this paper, implies the abnormal. Twenty-five cases were studied. The records consisted of the following: clinical findings, cephalometric roentgenograms, temporomandibular roentgenograms, photographs and models.

Asymmetry may be the result of a warping of the growth pattern of the face, destruction of a vital growth center, paralysis and other conditions that exert an influence during the growth period. On the other hand, there are those cases of asymmetry that may occur immediately because of loss of bone from the jaws. This type of asymmetry should receive considerable attention from the dental and the medical profession today.

In normal times, this deformity is usually found only in elderly persons as a result of resection of bone from the mandible or maxillae for the treatment of carcinoma. The control of the disease, for relief of pain and prolongation of the life of the patient, is the primary consideration. The facial deformity, unless it is extreme, is not given much thought because of the patient's advanced age.

In time of war, however, these cases of asymmetry occur in young men because of destruction of bone and soft tissue by projectiles. These injuries will also occur among civilian populations subjected to air raids. Many of the victims will be children, this fact complicating the control of the deformity. In the case of a projectile wound of the jaws, as in any wound, the first step must be to save life. The second, but also important, step must be to prevent or correct the facial deformity that will accompany the healing process. These young men must be restored so that they can resume their place in society.

The prevention of these deformities demands the unified action of the surgeon, oral surgeon, orthodontist and prosthodontist. Their treatment and responsibilities are different, but the goal, the restoration of the face as nearly as possible to balance and symmetry, must be the same. The rôles of persons managing such a case can be briefly indicated as follows:

1. Surgeon: Emergency treatment to save life.

2. Orthodontist or dentist: Construc-

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From the Department of Orthodontia and the Department of Oral Anatomy, University of Illinois, College of Dentistry.

tion of an appliance to move the remaining bone fragments to correct relation and to maintain that relationship.

3. Oral or plastic surgeon: Necessary bone implantation and plastic operation.

4. Prosthodontist: Prosthetic restoration that will assist in the maintenance of correct bone and soft tissue relations.

The fact that a man is a surgeon, orthodontist or prosthodontist does not necessarily qualify him to participate in the management of these cases. It is only when he has an understanding and appreciation of the functional anatomy of the head and neck that he can fulfil his responsibilities to the patient. The dental profession must now prepare itself, because most of its members will come in contact with these cases during or after the war.

Brodie's studies on the growth of the head illustrate a number of anatomic principles that are important. In a serial x-ray study of growing children, he observed that the relationship of the mandible to the maxillae and cranium is established very early, before any teeth erupt. The jaws of the infant are not in approximation as they are usually illustrated. (Fig. 2, left.) They are separated with the tongue protruding between them, supporting the lips. This relationship of mandible to cranium can be recorded by measuring the angle formed by a line drawn tangentially to the lower border of the mandible with the line

ETIOLOGIC FACTORS IN CASES OF ABNORMAL FACIAL ASYMMETRY

A: Direct injuries to and loss of bone.
- 1. Infection (osteomyelitis).
- 2. Fractures with malunion or non-union.
- 3. Loss of bone due to: (a) trauma (projectiles) or (b) resection (carcinoma).

B: Direct injuries of growth sites.*
- 1. Prenatal injuries, with distortion of growth pattern.
  - 1. Abnormal position of embryo.
  - 2. Intra-uterine tumors of mother.
- II. Birth injuries, with or without distortion of growth pattern, depending on sites affected.
  - 1. Precipitate delivery.
  - 2. Breech presentation and obstetrical injuries.
- III. Postnatal injuries.
  - 1. Destruction or disturbance of growth center at head of condyle.*
    - (a) Infections (with or without ankylosis)
    - (b) Traumatic (fall or blow on chin transmitted to temporomandibular joint followed by traumatic arthritis, fibrosis or ankylosis.
  - 2. Tumor in temporomandibular joint.

C: Indirect effects upon growth sites of neuromuscular afflictions.*
- I. Prenatal injuries (congenital nerve and muscle afflictions centered about head and neck).
- II. Birth injuries (brain injuries resulting in paralysis).*
- III. Postnatal injuries
  - 1. Spastic paralysis.
  - 2. Curvature of spine.
  - 3. Torticollis.
  - 4. Postural defects.
  - 5. Tumors.
  - 6. Poliomyelitis.
  - 7. Muscular hypertrophy.

D: Idiopathic factors.

*The severity of the asymmetry and the age at which the etiologic condition develops, are directly proportionate. Therefore, ankylosis is much more serious in a child of 3 years than in a person of 15 or 20 years, since the deformity will become progressively worse as the growth continues in the other normal growth centers of the head and face.

connecting the nasion and sella turcica. (Fig. 2, right.) This angle does not change with subsequent growth.

Since the position of the mandible is established before any of the teeth have erupted, this relationship must be dependent on the musculature attached to the mandible. In order to understand this function of musculature, the posture of the head on its flexible spinal column must be observed. Bilaterally, the posture is maintained by balanced tonicity of paired muscles. Figures 4 and 5 illustrate this symmetrical arrangement both anteriorly and posteriorly from the spinal column. Anteroposteriorly, however, the maintenance of posture is not so evident, for two reasons: First, there is more weight anteriorly from the spinal column than posteriorly, and thus gravity becomes a factor. Second, the muscles anteriorly from the spinal column are entirely different in size and arrangement from those posteriorly. (Fig. 6.) The postcervical muscles are very powerful, and as they pull downward and backward on the head, their force more than equalizes the anterior force of gravity. The action of this muscle group must be counterbalanced by more than gravity; otherwise, the head would be carried backward. A continuous sheath of muscles from cranium to thorax would balance the posterior muscles, but would not permit mastication, deglutition or respiration.

Fig. 1.—Left: Normal face. Center: Right side. Right: Left side.

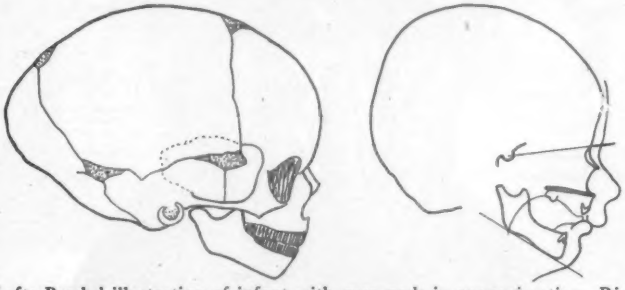

Fig. 2.—Left: Brashs' illustration of infant with gum pads in approximation. Right: Tracing of cephalometric roentgenogram of infant, showing correct relationship of mandible and maxilla. (Brodie.)

Each of these functions calls for the movement of different parts and, as a result, the anterior muscular arrangement is in the form of a chain, each link of which is capable of independent, but coordinated action. The chain as a unit

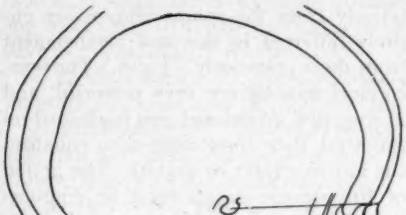

Fig. 3.—Superimposed tracings of head x-ray films at ages 3 months, 3 years and 8 years, showing orderly behavior of growth pattern. (Brodie.)

necting the mandible with the cranium; the suprahyoids, suspending the hyoid bone and larynx from the chin point and base of the cranium, and the infrahyoids, connecting the hyoid bone and thorax. The spatial relationship of the parts is maintained by the tension of these muscular groups. Thus, the position of the mandible at rest is determined, not by the teeth, but by the musculature running to the mandible from above and below, the same as the hyoid bone.

Any disturbance in the continuity of the mandible will upset this muscular balance. Normal muscular tension could then cause displacement of the bony parts. The balance can be reestablished only when the segments of bone are restored to their proper relations.

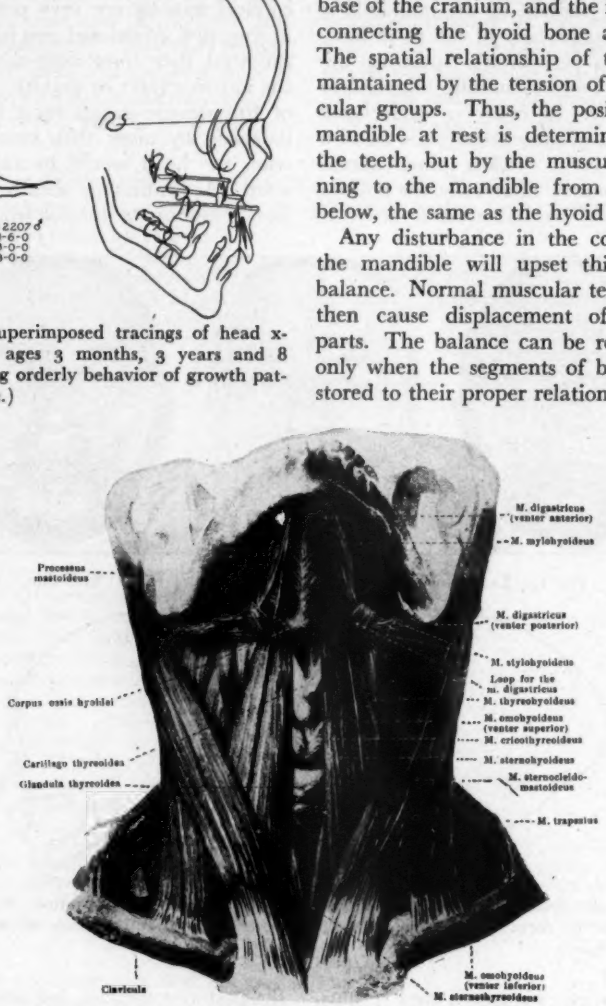

Fig. 4.—Bilateral symmetry in number and line of action of muscles anteriorly from spinal column. (Spalteholz.)

counteracts the excess pull of the posterior group and maintains the posture of the head.

The chain is composed of three major links: the muscles of mastication con-

Brodie's studies further revealed that the lower border of the mandible descends in parallel planes as does the occlusal plane and the floor of the nose. Anatomic landmarks, such as the anterior

nasal spine, tip of the maxillary incisor and chin point, move downward and forward on a series of straight lines. It is evident that the growth pattern is stable and that the proportions of the face do not change. The nasal height was found to contribute 43 per cent to the total face height.

The components of vertical growth in the anterior part of the face are four: the maxillary, maxillary alveolar process, mandibular alveolar process and mandibular growth. Since the growth pattern

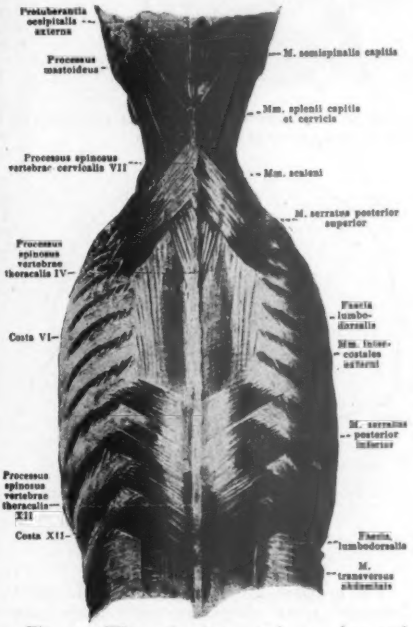

Fig. 5.—Bilateral symmetry in number and line of action of muscles posteriorly from spinal column. (Spalteholz.)

is stable, this anterior vertical growth must be equaled by growth in the back of the face. There is only one site of growth that accounts for this vertical growth; that is, the head of the condyle, which must grow at a rapid rate in order to equalize in growth the four anterior growth factors. It is important to fully appreciate the condyle growth center since a disturbance at this site is frequently responsible for deformity of the face.

The etiology of certain cases of asymmetry is obvious, as in loss of bone or destruction of a growth center. In others, it is rather vague. Our knowledge of these conditions will increase only when serial studies, beginning at birth, are undertaken with the common interest and cooperation of the obstetrician, pediatrician and orthodontist. The accompanying chart attempts to classify types of facial asymmetry, using the etiologic factor and its manner of effect as a basis. The cases will be discussed in the same

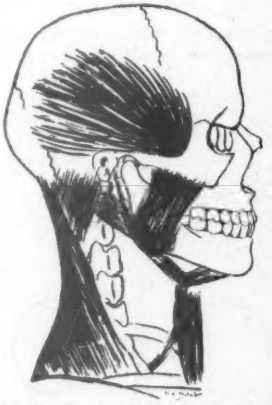

Fig. 6.—Posture of head is maintained by a balance of the muscles anteriorly and posteriorly from the spinal column. (Kloehn.)

order and will illustrate the disturbed form, muscular balance and function.

Case 1 is that of a man, aged 20. (Fig. 7.) Four years ago, he was operated on for the removal of a mixed-cell tumor of the left parotid gland. Osteomyelitis developed after the operation and a section of the mandible from the left bucuspid area extending up into the ramus was lost. X-ray therapy was continued to the extent that there is now a large reddish avascular mass of scar tissue on the left side of the face and neck. The photograph and the frontal head plate reveal that the chin is markedly displaced to the left. This displacement is primarily the re-

Fig. 7 (Case 1).—Loss, by osteomyelitis, of section of bone from bicuspid area to ramus on left side, comparable to those cases in which bone has been destroyed by projectile.

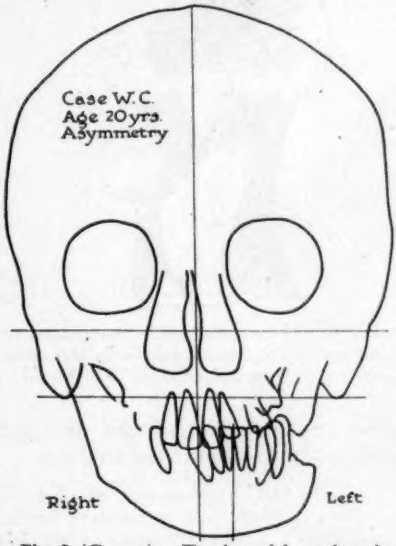

Fig. 8 (Case 1).—Tracing of frontal cephalometric x-ray film illustrating facial asymmetry.

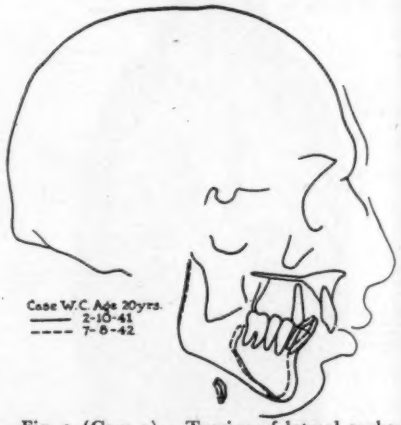

Fig. 9 (Case 1).—Tracing of lateral cephalometric x-ray (superimposed) films made February 10, 1941 and August 8, 1942. The asymmetry has become more severe.

sult of the unopposed tension of the right mylohyoid muscle (Fig. 10) and the backward and downward pull of the geniohyoid and genioglossus muscles. The lateral headplate (Fig. 9) shows that the remaining portion of the left ramus is pulled upward and forward by the temporal muscle. It also reveals that the deformity has become worse in the year and a half that has elapsed between the two sets of cephalometric x-ray pictures.

The maxillary arch form has been modified, as well as the mandibular. The movement of the right body of the mandible to the left has increased the pressure of the right buccinator muscle on the right maxillary cuspid and bicuspids. These teeth have

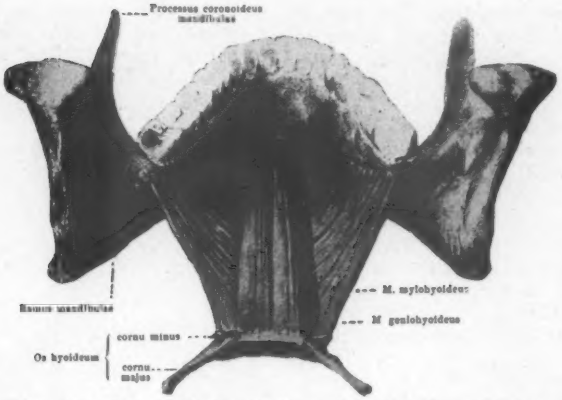

Fig. 10.—Posterior view of mandible illustrating mylohyoid and geniohyoid muscles. (Spalteholz.)

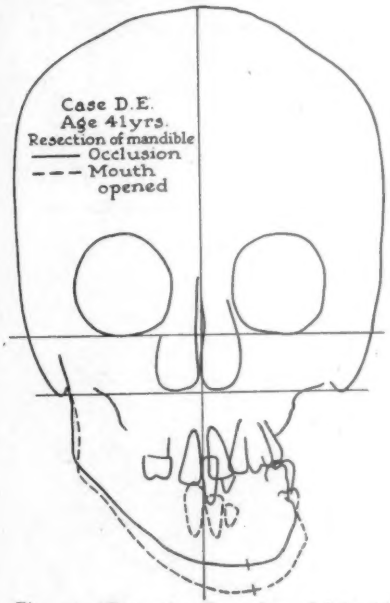

Fig. 11 (Case 2).—Resection of left side of mandible from bicuspid area to condyle.

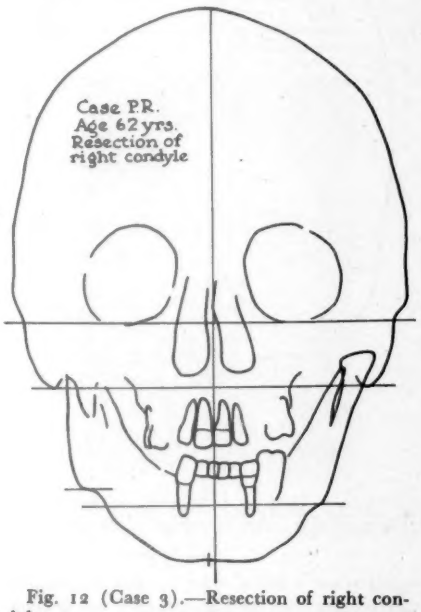

Fig. 12 (Case 3).—Resection of right condyle.

responded to this disturbed balance by tipping lingually.

The successful restoration of this face can be accomplished only with the cooperation of an orthodontist, to correct the malocclusion and control the position of the large fragment of the mandible, and a plastic surgeon, to replace the avascular tissue and restore the lost bone with bone or cartilage implants. Later, the services of a prosthodontist will be required to replace the missing teeth with a restoration that will assist in maintain-

ing correct jaw relations. This case is comparable to those that will occur as the result of projectile wounds of the face.

The disturbed function associated with this type of asymmetry is illustrated in Case 2, in a woman aged 41. (Fig. 11.) The left side of the mandible from the bicuspid area to the condyle was resected in the treatment of a carcinoma. The chin is deviated to the left by the unopposed contraction of the right mylohoid muscle. As the mouth is opened, the midline of the mandible deviates farther to the left as the right external pterygoid alone is functioning to open the mouth. At present, the only disturbance has been in the mandible. However, in the maxillary dental arch, a change will occur as it did in the previous case.

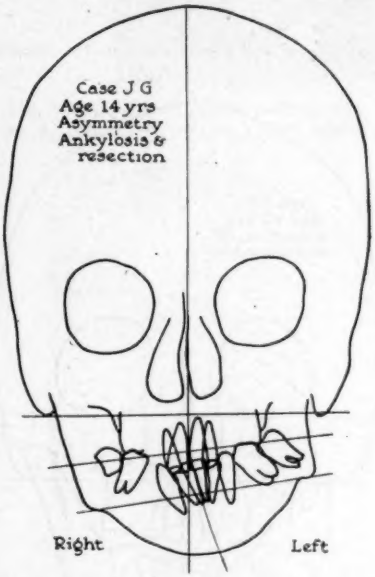

Fig. 13 (Case 4).—Ankylosis of left temporomandibular joint at age of 2½ years.

The extent of the deformity from loss of bone is dependent on the amount of bone that has been lost, as the muscular balance is proportionately disturbed.

In Case 3 (Fig. 12), in a patient aged 62, only the right condyle has been resected; therefore, only the right external pterygoid is out of function. The midline of the mandible has deviated to the right, but the extent of deviation is much less than in Cases 1 and 2. On opening the mouth, the midline will move to the right as only the left external pterygoid is functioning.

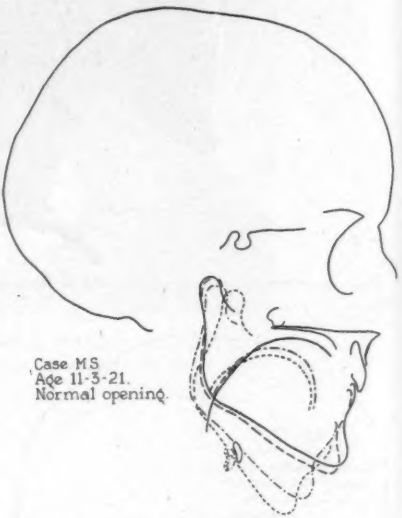

Fig. 14 (Case 4).—Normal opening.

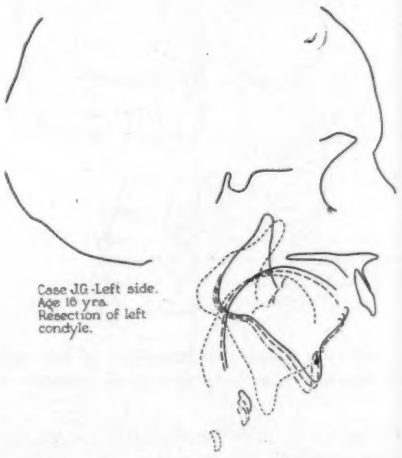

Fig. 15 (Case 4).—Abnormal opening.

Fig. 16 (Case 5).—Destruction of growth center at right condyle by infection.

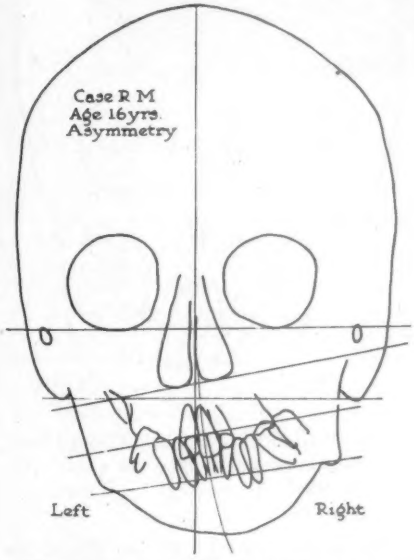

Fig. 17 (Case 5).—Tracing of frontal x-ray film illustrating asymmetry.

Fig. 18 (Case 6).—Asymmetry caused by tumor in right mandibular fossa displacing head of condyle. (Brodie.)

The next type of asymmetry is one in which the deformity is not evident immediately. It is the result of destruction or restriction of the growth center at the head of the condyle. The severity of the asymmetry is dependent on the age at which the growth center is affected. The earlier the affliction occurs, the more severe the deformity when growth of the normal side is completed.

In Case 4, in a youth aged 16 years (Fig. 13), the left temporomandibular joint became ankylosed at 2½ years and it remained so for eleven years, until the condyle was resected. The cephalometric roentgenograms were made three years later.

The left mandibular ramus is much shorter than the right because of the destruction of the left condyle growth center. The ramus is then only as long as it was at 2½ years of age. Since that time, the normal growth of the right condyle has caused the chin to deviate progressively to the left. The entire vertical growth of the left side of the face has been inhibited; consequently, the nasal floor, occlusal plane and mandibular angle are at a higher level on the left side than on the right. The deviation of the facial midline to the left becomes more severe from above downward, because more components of growth are involved. The cranium is symmetrical, since most of the cranial growth was completed before the onset of the ankylosis. The malocclusion, a Class II, is more severe on the left side. The occlusal plane is tipped and this type of case is

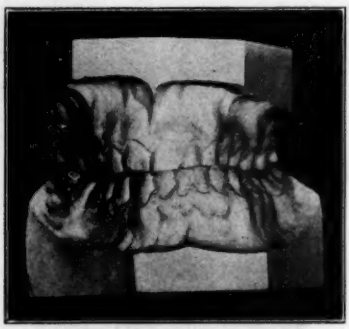

Fig. 19 (Case 6).—Models illustrating malocclusion.

usually complicated by the loss of one or more permanent molars. Orthodontic treatment is extremely difficult and there is much to be desired in the final result. The important reason for treatment is esthetic improvement.

The restricted movement of the ankylosed joint has brought about functional changes in the anterior muscular chain. In the normal opening of the mouth (Fig. 14), the external pterygoid muscle plays the major rôle in pulling the head of the condyle downward and forward. As this muscle contracts, the masseter, internal pterygoid and temporal muscles must relax proportionately. The suprahyoid muscles contract in order to allow the position of the hyoid to be maintained as the mouth opens. The posture of the head is not disturbed since the tension of the chain as a unit has not been altered, even though that of the individual links or muscle groups have changed.

If the movement of the mandible is restricted by an ankylosis, the suprahyoid and infrahyoid groups are brought into play in the attempt to open the mouth. After the resection of the ankylosed condyle, these muscles supplant the loss of the one external pterygoid.

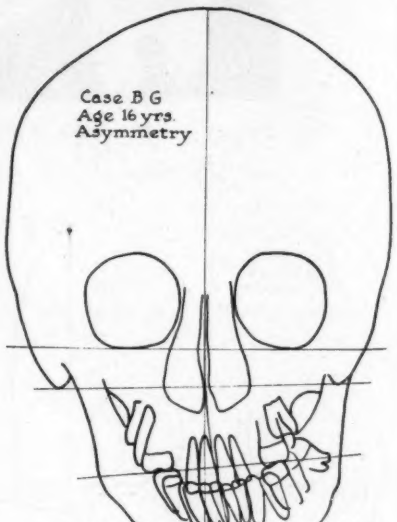

Fig. 20 (Case 7).—Tracing of frontal x-ray film illustrating asymmetry. The growth pattern is warped.

In Case 4 (Fig. 15), the hyoid bone has been pulled well below the level of the chin by contraction of the infrahyoids. This places the suprahyoid muscles in a position of mechanical advantage to open the mouth. The postcervical muscles must necessarily increase their tension; otherwise, the head would be pulled forward.

The growth center of the condyle can be destroyed or restricted without the occurrence of an ankylosis. In Case 5, a boy aged

16 years was severely burned on the right arm and leg when he was 1½ years old. A septicemia developed and one of the areas where the infection localized was the right temporomandibular joint. The condyle growth center was destroyed, but ankylosis did not occur. The external pterygoid muscle on that side cannot function, probably because of the presence of scar tissue.

Figure 16 shows the chin deviated to the right. The left side of the face is flattened and the right side is rather full. In the frontal head plate (Fig. 17), the left ramus is seen to be longer than the right. The nasal floor, occlusal plane and angle of the mandible on the right side are at a higher level than the left. The lack of height on the right side is the result of destruction of the right condyle growth center. Function has been altered, as it was in Case 4, so that the hyoid muscles assist the left external pterygoid to open the mouth.

The treatment for cases of this type is very inadequate. At present, all that can be done is to build out the flat side of the mandible, the normal side and the chin with cartilage implants. The orthodontic treatment consists primarily of retraction of the maxillary incisors. This usually necessitates the extraction of the first bicuspids. The limitation imposed by the fact that there is failure at one of the most important growth centers in the body, the head of the condyle, may never permit any better treatment.

Another type of asymmetry involving the temporomandibular joint is caused by a tumor in the mandibular fossa.

In Case 6 (Fig. 18), the right condyle has been displaced forward out of the fossa. The chin has deviated to the opposite side. The malocclusion consists of a crossbite on the left side with the maxillary teeth lingually from the mandibular. The maxillary right bicuspids and cuspid have shifted lingually in response to the increased tension of the right buccinator muscle. The lower midline has been displaced to the left almost the width of a lower central incisor. As the mouth often opens, the midline deviation is corrected. This type of case is progressive, as the tumor enlarges and further displaces the condyle. Its correction lies in the removal of the tumor, and orthodontic treatment to correct the malocclusion.

Fig. 21 (Case 7).—Models before and after orthodontic treatment.

Fig. 22.—Reproduction of probable intrauterine pressure. (Parmelee.)

The next few cases are those in which the etiology is not so evident. Appraisal

of the cases suggests the possibility of certain etiologic factors being active.

In Case 7 (Fig. 20), there appears to be warpage of the growth pattern. The asymmetry involves the upper face and the deviation to the left becomes more severe from above down. The left ramus is the shortest and the left mandibular fossa appears to be higher than the right; thus, the base of the skull is affected. The malocclusion (Fig. 2) is Class I. No crossbite exists, but the maxillary and mandibular dental arches appear to have been sheared in their alveolar processes. The left mandibular teeth are markedly inclined lingually while the right mandibular teeth are leaning buccally so that they are well "off the ridge." They appear to be reaching for occlusion with the maxillary teeth. In the other cases of assymmetry of this type, a crossbite exists on the side toward which the chin is deviated. The crossbite is the result of disharmony in the lateral relation of the jaws. The orthodontic treatment in Case 7 (Fig. 21) did not influence the asymmetry.

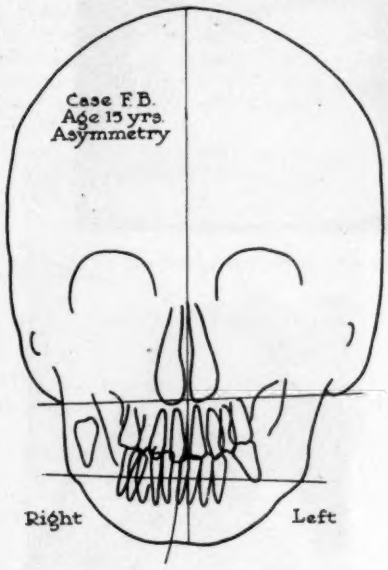

Fig. 23 (Case 8).—Tracing of frontal x-ray film illustrating asymmetry.

The early photographs definitely suggest asymmetry. Although there is no history of the case, it is probable that the warping of the growth pattern occurred because of abnormal intra-uterine pressure or difficult delivery.

Parmelee reported two cases in which the face was badly warped. Figure 22 shows the probable intra-uterine position causing undue pressure on the face. If the warping is not too severe and if the muscular tension is normal, the normal patterns will be reestablished.

It is possible to have a combination of abnormal intra-uterine pressure and birth injury acting at the same time. Such a case was reported by Brodie.

Fig. 24 (Case 8).—Facial asymmetry associated with disturbance of posture. They are undoubtedly associated.

The face was warped because of abnormal pressure by an intra-uterine tumor of the mother. The delivery was with forceps and the fifth, seventh and eighth cranial nerves were injured. The resulting muscle paralysis prevented a normal balanced musculature to remold the warped bony pattern and, in turn, contributed to making the asymmetry progressively worse.

The final case (Case 8) for considera-

tion is also one of warping of the growth pattern (Fig. 23), but it is of later origin.

The photographs of this case up to the age of 12 years show the face to be pleasing and well balanced. One made approximately three years later shows the face to be thinner and asymmetrical. The general posture (Fig. 24) is disturbed so that the shoulder on the side toward which the chin is deviated is at a lower level than the other. The posture suggests lateral curvature of the spine.

Whitman is of the opinion that the largest and most important class of curvature of the spine is idiopathic curvature. It occurs most commonly in the period from 12 to 16 years, and more often in girls than in boys. This is interesting since only one of the eleven cases of unknown etiology was in a boy.

Other cases of asymmetry appeared to be limited to the mandible. The chin is always deviated toward the side of the short ramus, and the angle of the mandible on that side is always more obtuse. The mandibular teeth on the side toward which the chin is deviated are usually buccally from the maxillary teeth.

The treatment of these cases can lie only in the sectioning of one or both rami horizontally and in repositioning the mandible. This must be preceded by orthodontic treatment so that the teeth will occlude in the desired mandibular position. The success of the operation cannot be determined immediately despite the facial improvement, as lack of balance of the musculature may reestablish the asymmetry. Some of these cases of asymmetry will be treated in this manner.

I wish to direct my concluding remark to the orthodontist. Malocclusion is not one of the causes of asymmetry of the face, but rather is one of the symptoms. The orthodontic treatment may straighten the teeth, but it will not straighten the face.

BIBLIOGRAPHY

1. BRODIE, A. G.: Growth Pattern of Human Head from Third Month to Eighth Year of Life. *Am. J. Anat.*, 68:209, March 1941.

2. *Idem:* Behavior of Normal and Abnormal Facial Growth Patterns. *Am. J. Orthodontics*, 27:633-647, November 1941.

3. *Idem:* Differential Diagnosis of Joint Conditions in Orthodontia. *Angle Orthodontist*, 4:160, 1934.

4. KLOEHN, S. J.: Application of Biological Principles to Treatment of Jaw Fractures. *Angle Orthodontist*, 10:94, April 1940.

5. MASSLER, MAURY: Unpublished data.

6. PARMELEE, A. H.: Molding Due to Intrauterine Pressure. *Am. J. Dis. Child.*, 42: 1155, November 1931.

7. THOMA, K. H.: Oral Pathology. St. Louis: C. V. Mosby Co., 1941.

8. THOMPSON, J. R.: Cephalometric Study of Movements of Mandible. J.A.D.A., 28:750-761, May 1941.

9. THOMPSON, J. R., and BRODIE, A. G.: Factors in Position of Mandible. J.A.D.A., 29: 925-941, June 1942.

10. WHITMAN, ARMITAGE: From Head to Foot. New York: Farrar and Rinehart, 1939.

11. WOLFF, W.: Right and Left Face. *Ciba Symposia*, 3:1136-1138, February 1942.

12. WRIGHT, C. F.: Occlusal Reduction in Jaw Fracture Management. *Angle Orthodontist*, 7:67, April 1937.

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HISTOLOGIC CONSIDERATION OF THE SUPPORTING TISSUES OF THE TEETH

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INTRODUCTION

SCIENTIFIC work, in its relationship to the daily practice of a profession, can be differentiated into: 1. Work that has no direct bearing on professional problems, but is mostly concerned with the solution of preproblems the study of which is supposed to help in solving problems that have closer contact with practice. Few practitioners enjoy such study. 2. Scientific work that has a direct relationship to daily practice.

Sometimes, we hear expressed a disbelief in certain histologic findings, because they cannot be proved clinically. Such a statement is obviously based on a misunderstanding. Things that we see without magnification (clinically) can be checked by magnification (microscopically). But we can never check without magnification things that are evident only on a high magnification.

Frequently, we are confronted with a definite separation of clinical from histologic work. Investigation of our clinical problems with the microscope does not represent an action that is foreign to clinical observation: it merely completes and broadens clinical observation. The latter is limited to a certain extent. Things that we cannot observe clinically, we have to "guess at," finally resorting to a belief in miracles. Using the microscope in connection with experimentation, we often are able to collect additional valuable information for clinical use. Let us consider the following presentation from that point of view.

From the Department of Oral Pathology and Dental Research, Baylor University, College of Dentistry.

Read at the Seventy-Ninth Annual Midwinter Meeting of the Chicago Dental Society, February 24, 1943.

NORMAL HISTOLOGY OF THE SUPPORTING TISSUES

In the human body, pressure is transformed into traction wherever possible. The bones prefer traction because they can respond to the requirements of that mode of action in an ideal way. The human being, standing on two limbs, is forced to tolerate bone pressure on the vertebra and its prolongation in the two legs. Here, transformation of pressure into traction is impossible.

In the suspension of the tooth in its alveolar housing, the reverse is true. Clinical observation alone could not determine that the teeth do not rest on the bone, but are suspended by ligaments. If here we were entirely dependent on clinical observation, innumerable blunders would necessarily follow. Figure 1 illustrates how the suspensory fibers of the periodontal membrane run obliquely from the bone to the tooth in an apical direction, thus keeping the tooth suspended. It is obvious that the firmness and functional ability of such a suspended tooth depend on the number of the fibers that provide the suspension. Two conditions govern the efficiency of this fibrous suspension:

1. The density with which the fibers are inserted. This depends on whether the entire available root surface has fibers fixed upon it. We know that newly

deposited cementum performs that function excellently. Figure 2 shows a layer of freshly deposited cementum on the base of a resorbed area. Numerous fibers appear to be embedded in the new cementum layer, fixing the tooth to the bone. Thus, it seems desirable that new cementum layers be continuously deposited on the root surface, for satisfactory fixation of new fibers. Figure 3 shows the part of a root surface that already has a thick layer of cementum. Nevertheless, we see a layer of cementoblasts forming a new cementum layer and including additional new fibers.

Fig. 1.—Periodontium of human tooth. a, tooth. b, bone. c, periodontal fibers fixing tooth to bone (in suspension).

2. The extent of the total area of the clinical root surface that is available for insertion of fibers. If a tooth has several roots, the available surface is greater than in a tooth that has only one root of the same length. We know that continuous passive tooth eruption is a fact. The epithelial attachment separates the clinical crown from the clinical root and its movement apically throughout life, though at different rates, decreases the available surface for the insertion of fibers. The down-growth of the epithelial attachment is checked by the continuous deposition of new cementum layers. Figure 4 shows a tooth of a squirrel, with deposition of a new cementum layer opposite the epithelial attachment, apparently preventing the epithelium from growing farther along the root surface.

Fig. 2.—a, bone. b, area of tooth resorption repaired by newly deposited cementum layer. c, compactly arranged fibers fixing part of tooth to bone.

Only the continuous elongation of the root, by deposition of new cementum at

the apex, counteracts the shortening of the clinical root. Figure 5 illustrates how cementum deposition elongates a root. However, only in rare cases is that elongation able to compensate for the shortening of the clinical root by the apical movement of the epithelial attachment. Thus, we must realize that the cementum plays an important part in the fixation and functional ability of the teeth from every point of view.

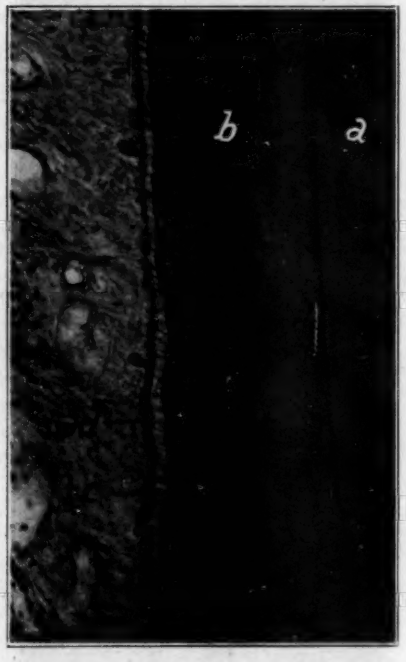

Fig. 3.—a, dentin. b, cementum. d, cementoblasts forming additional layer of cementum. c, new fibers incorporated in cementum.

Fig. 4.—Epithelial attachment in squirrel. a, enamel. b, epithelial attachment. c, calcified cementum. d, layer of uncalcified cementum seemingly acting as barrier to downward growth of epithelium.

NORMAL PHYSIOLOGY OF THE SUPPORTING TISSUES

The teeth, since they are normally not ankylosed to the bone, but are rather suspended in it by a fibrous attachment, naturally exhibit mobility which, up to a certain degree, we might call physiologic except that the term might create some misunderstanding. The term physiologic often means something that is good for the tissue or for the individual. That meaning does not apply to the term physiologic mobility, which means only that the vast majority of teeth show a certain mobility. It does *not* mean that a certain degree of lowered mobility indicates a pathologic condition. We can hardly imagine that a tooth might be found pathologic because it is too firm. Automatically, we might think of ankylosis. Except for a shortening of the tooth, if in a young person, we can hardly call even such a tooth pathologic from a clinical point of view. We are in the habit of reserving that word for cases in which an impairment of the concerned conditions is produced.

It might seem that such a discussion is superfluous. However, this is not the case, since an important argument against fixed bridgework has been the erroneous belief that, by fixing teeth rigidly together, the existing conditions are impaired and the teeth lose their physiologic mobility. Such a statement seems to be based upon a misunderstanding.

It might be useful to discuss on what the mobility of a tooth depends. In addition to the above-mentioned histologic facts, it is the width of the periodontal membrane that is decisive. Under the same histologic conditions, a tooth having a narrow space between tooth and bone will exhibit a greater firmness than a tooth having a broader space. The width of the periodontal membrane depends to a great extent on function. If ankylosis is not present—and that is the normal situation—every functional movement, buccally or lingually, means a widening of the periodontal space. Since the fulcrum in such a movement is at a point somewhat apically from the middle of the clinical root, a movement diagnally will result, the apex moving in a direction opposite from that of the crown. Any pressure of the tooth against the bone results in bone resorption.

Thus, the shape of a periodontal membrane corresponds to the function of its tooth. Most of the functional movements have lateral components. Thus, the marginal and apical width of the periodontal membrane is greatest, while, at the level of the fulcrum, the membrane will be the narrowest. The result is that the function and the width of the periodontal membrane influence each other to a great

Fig. 5.—Apex of human tooth. a, pulp. b, periodontal membrane. c, bone. d, dentin. e, cementum.

Fig. 6.—Tooth without antagonist. a, narrow periodontal membrane.

extent. The greater the functional mobility that a tooth exhibits, the more its periodontal housing is widened, and the greater becomes the mobility of the tooth. From this fact, we must assume that the mobility, once it is increased, is bound to progress.

In a tooth under function widening its periodontal space, that space has a physiologic width, which means that it is wider than when not being broadened in function. In histologic study of teeth without antagonists or impacted teeth, we always find a narrow periodontal space, while the fibers of such a periodontal membrane consist of loose connective tissue having no functional arrangement.

Figure 6 shows the periodontal membrane of a tooth without an antagonist, having a narrow space between tooth and bone.

Figure 7 shows a carious root with periapical inflammation. At the points where periapical inflammation does not affect the bone, and does not prevent cementum deposition, is a narrow periodontal space.

Figure 8 shows an impacted upper cuspid and a functioning bicuspid.

Figure 9 shows a higher magnification of both periodontal membranes where they are adjacent.

The periodontal membrane of the functioning tooth is wider than that of the impacted tooth. In all these cases, something prevents ankylosis of non-functioning teeth, and maintains a narrow periodontal membrane. That indicates that maintenance of the periodontal separation of the tooth from the bone has a biologic and not a mechanical basis. We call the reduced width of the periodontal membrane of non-functioning teeth the biologic width, indicating that only biologic rules determine that width.

Here we must discuss the damage resulting from the extraction of teeth from the arch. If no teeth are missing, the contacts prevent the teeth from moving mesiodistally, and functional widening of the periodontal space is probably limited to the buccal and lingual sides. If we remove a tooth from the arch, we rob its neighbors of its support mesiodistally. Under otherwise unfavorable conditions, an additional mobility mesiodistally might result in a reduction of the functional ability of the tooth. It is not compensated by the fact that no pockets develop on these free planes when there occurs a more rapid apical movement of the base of the crevice. Denudation takes the place of pocket formation be-

Fig. 7.—a, narrow periodontal space.

cause no neighboring tooth is present to keep the gingival margin high.

Immobilizing teeth with a high degree of mobility by fixed bridgework might turn the tide. Reducing the mobility through fixation will decrease the periodontal space and, in turn, increase the functional ability of the tooth concerned, provided no pathologic condition interferes.

The same principles of fixation can be applied to some extent in considering removable partial dentures. Specialists in this field emphasize that overloading the supporting teeth in the axial direction is far less harmful than with a horizontal component. Judging from the histologic results of experiments, we have to agree with that statement. If we press a tooth into the alveolus, we move the tooth into a space of narrowed diameter, thus decreasing the width of the periodontal space, in addition to bringing the alveolar margin nearer to the base of the crevice. Moving a tooth in any other direction, we widen the alveolus. Correspondingly, any type of restoration which comes nearest to using the supporting teeth in their axial direction is preferable.

Fig. 8.—a, impacted cuspid. b, functioning bicuspid.

Figure 10 illustrates the damage that can be done by a horizontal component of overload. It is the result of an experiment on the tooth of a dog. We see considerable resorption of the alveolar margin of the bone, which constitutes injury.

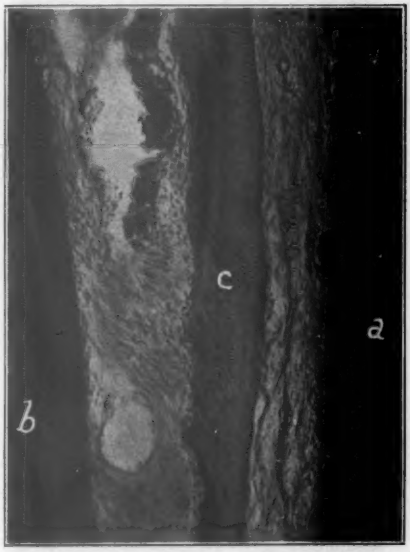

Fig. 9.—a, impacted cuspid. b, functioning bicuspid. c, bone separating two periodontal membranes.

Figures 11 and 12 illustrate the result of axial overloading.

Figure 11 illustrates how the root is pushed deeper into the alveolus, the alveolar margin extending nearer to the cemento-enamel junction.

Figure 12 illustrates how the base of the alveolar bone is resorbed and a new, more deeply situated base is built.

We often hear the question: How is space made available for continuous deposition, as shown in Figure 2? Is cementum deposition able to cause resorption of bone? The actual facts are quite different. We have two possible means of getting a transitional widening of the periodontal space. If the tooth, in the course of continuous active eruption, comes out of its alveolus, there is temporarily a widened periodontal space. Further, if a tooth is by any means pressed against the bony wall, there is resorption of bone, and that represents another occasion of widening of the periodontal space.

Fig. 10.—Lateral movement of dog's tooth. a, destroyed periodontal membrane. b, tooth resorption area. c, area of considerable loss of bone at alveolar margin.

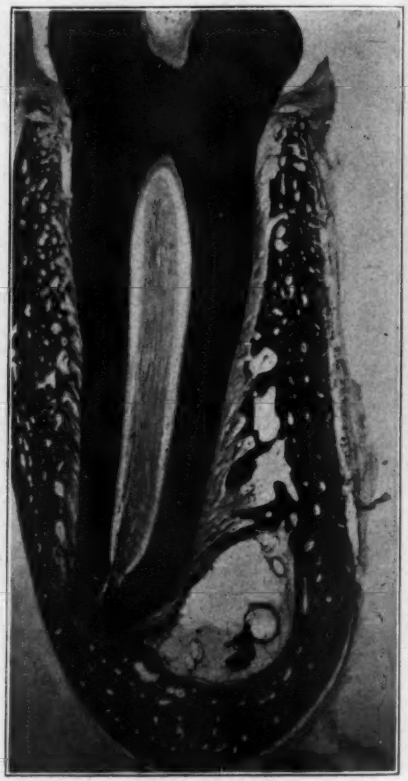

Fig. 11.—Experimental overload of dog's tooth in axial direction. The alveolar margins have been brought nearer to the cemento-enamel junction.

When we talk of continuous cementum deposition, we do not mean that a bulk of cementum is forcibly deposited in spite

of a lack of space for accommodation. Apparently, that does not happen even in cementomas. We might put it in the following way: Any widening of the periodontal space can be reduced by cementum or bone deposition. If such widening is reduced at least partly by cementum deposition, a high vitality of the tooth is indicated. How much cementum is deposited in such a situation depends entirely on the available space. We know that the thickest cementum is to be found at the apex of the root, and at the bifurcation in multirooted teeth.

Fig. 12.—Experiment similar to that referred to in Figure 11. The old alveolar bone at the apex (a) is being removed by resorption. Deeper, new alveolar bone (b) is forming.

In Figure 13, the cementum is thickening toward the apex of the root.

Figure 14 shows a human first molar before eruption. In spite of the fact that the cementum at the cemento-enamel junction is older than that at the bifurcation, the latter is much thicker.

The predilection for these two places is explained by the fact that when a tooth moves out of the alveolus, the widening of the periodontal space at these two places is far greater than at the sidewalls of the same tooth. More space being made available, more cementum is deposited at these two places. Biologically, it is of no importance how thick a cementum layer has been deposited. It is the continuous deposition of cementum that is decisive. This continuous deposition was shown by Schour in the molars of rats by staining with alizarin injections.

We still have to discuss the main physiologic problem concerning the supporting tissues; namely, the physiologic rest position. Human teeth have two natural reasons for existence: first, the chewing of food; and, second, their esthetic value. We need teeth for the chewing of food for about thirty minutes and not more than one hour out of each twenty-four. If we keep the upper and the lower teeth apart, not bringing them into contact during the other twenty-three hours, there would, it seems, be no

Fig. 13.—Cementum (a) thickening toward apex.

possibility for traumatic occlusion. No matter how vigorously we masticate our food, if we give the periodontal membrane a rest for twenty-three hours a day, traumatic occlusion is impossible. If we can eliminate a pathologic condition, it is useless to discuss the pathologic importance of it. We produce traumatic occlusion by pressing the upper and lower teeth together between meals, as a result of habit or of nervousness. Orban

Fig. 14.—First molar before eruption. The cementum at the bifurcation is thicker than in any other place.

and Weinmann examined a great number of sections through human teeth under the microscope and could find scarcely a jaw that did not show at least on one tooth signs of damage to the periodontal membrane from undue pressure. That is never the result of grinding hard food, but of pressing the teeth against each other between meals. It is our duty as a profession to call attention to that fact, and to educate humanity to a proper rest position.

Especially now, the dental profession has a chance to repay the great service the fighting men are doing for humanity. We have an excellent opportunity to train the armed forces to become accustomed to a proper rest position of the jaws. The following dental slogan might be suggested by dentists in the armed forces. "Keep your teeth apart between

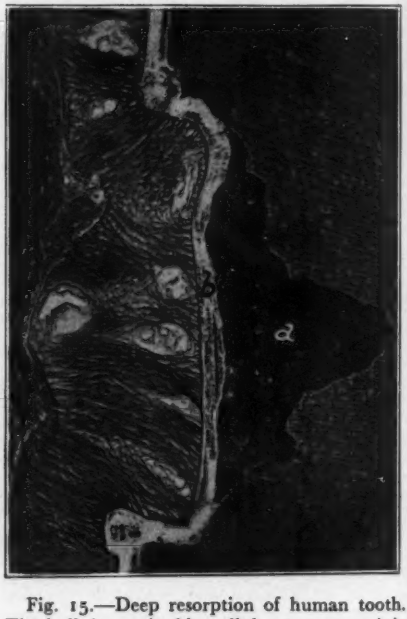

Fig. 15.—Deep resorption of human tooth. The bulk is repaired by cellular cementum (a). On the surface is a continuous layer of acellular cementum (b). The excellent condition of the periodontal fibers is evident (c).

meals." If the soldiers are not impressed with the importance of this, they will have many an occasion to set their jaws and grit their teeth, with much damage resulting.

It is a somewhat common belief that we must bring the upper and lower teeth into contact while swallowing. That is

not true, as any one can prove by trying to swallow with the teeth apart.

PATHOLOGY OF THE SUPPORTING TISSUES

Primary destruction of the alveolar bone through systemic disease such as tumor and tuberculosis, though sometimes of important diagnostic value, will not be considered here. Two histologic changes are important in the common pyorrheic loosening of the teeth: the rate with which the epithelial attachment moves apically and the maintenance of an intact cementum surface by the continuous deposition of new cementum. Definite histologic findings prove that newly deposited cementum layers act to check the apical movement of the epithelial attachment. Therefore, both changes can be looked upon as problems of cementum.

Because cementum is not a self-forming tissue, but is formed by the adjacent connective tissue of the periodontal membrane, there are those who assert that it is unjustifiable to speak of qualities of the cementum. Resorption, as well as apposition, is accomplished by the connective tissue. To clarify that question, a discussion of it might be advisable. All bone in the body is passive, just as the cementum is passive. But we continue to talk about "bone pathology" in spite of the fact that resorption and apposition of bone are accomplished by the adjacent connective tissue. The result of that activity is seen only at the surface of the bone, as the result of apposition and resorption is seen at the surface of the cementum. The periosteum and also the periodontium are serving their respective hard tissues, and, correspondingly, it seems justifiable to speak of the changing biologic character of these hard tissues.

In the case of the tooth, we have additional justification to concentrate our observation on the cementum. We all know that no matter how acute pyorrhea is, every symptom of the disease in the surrounding tissue disappears as soon as we have extracted the affected tooth. No disease of the alveolar bone and no pathologic symptoms of the remaining periodontal membrane can be observed afterwards. Correspondingly, all our efforts must be concentrated on the tooth. That the condition of neither the enamel nor the dentin can be blamed for a pyorrheic condition does not need discussion. Only the cementum has to be considered. We make that statement with the understanding that the adjacent soft tissue is included. The question as to whether the quality of the cementum surface is important for the development of different conditions produced by the adjacent connective tissue is omitted here. The whole problem concerning the functional ability of a tooth is a problem of its cementum.

Figure 15 might illustrate that point. Resorption has removed considerable tooth substance on a root deep into the dentin. At the time of the resorption, we cannot imagine that any fixation of that dentinal surface was present. The resorption area was repaired at first by cellular, then by primary cementum. We see the proof of a perfect functional restoration in the presence of the numerous fibers connecting the repaired cementum surface to the bone.

These statements do not mean that the cementum problem is merely a local one. We have indications that the condition of the cementum is controlled by some governing centers in the body, and that seems to represent the connection between pyorrhea and systemic disease. But, in order to determine whether "pyorrhea" is associated with systemic disease, and if so with which diseases, we must carefully turn our endeavors in two directions. At first, we must have a correct diagnosis. We should not call every case of neglected mouth hygiene pyorrhea, and check the presence of systemic diseases in these cases, lest a resulting low percentage of systemic con-

nection discourage the observer. It is of paramount importance that we arrive at some agreement as to diagnostic procedures. As soon as we can agree that the condition of the cementum should be the center of our investigation, we have to recognize definite clinical symptoms of changes in the cementum. We believe that two main clinical symptoms indicate pathosis of the cementum: irregular shifting of the epithelial attachment apically and irregular wandering of the teeth. We know that irregular shifting of the base of the crevice might result in pocket formation, or denudation, which are biologically the same. On the other hand, there are indications that the irregular wandering of the teeth is also connected with pathologic processes on the cementum. For the sake of differentiation, we call the disease showing these two symptoms diffuse atrophy of the alveolar bone. Cementopathia might be better. We have to bear in mind that, in the early stages, wandering might be discovered, and denudation or pocket formation might appear later. On the other hand, there might be considerable pocket formation and denudation without wandering, if isolated deep pathologic changes are not present.

Here, I must mention the relationship between loosening of the teeth and traumatic occlusion, both of which are secondary symptoms. With the apical movement of the epithelial attachment, the clinical root becomes shorter and a corresponding loosening of the tooth develops. Traumatic occlusion must result if migration is in a direction to interfere with occlusion. If an upper central incisor, for instance, migrates labially, there is no traumatic occlusion. If a bicuspid, with an antagonist still having well-developed cusps, migrates, traumatic occlusion must result.

Having carefully selected cases with proper clinical symptoms, we still must eliminate one more possibility of error. The activity of the process can be connected only with presently existing systemic trouble. For example, a patient may have acquired years ago a number of cavities that have remained unfilled and, at present, the acidophilus counts, which are used only to indicate susceptibility to dental caries, are negative. Immunity to new caries might exist in the presence of a dozen old cavities. The same applies to diffuse atrophy. Migration and pocket formation may be the result of some systemic trouble that was eliminated years ago. The migrated teeth and the pockets or denudation remain, without evidence of any present connection with a systemic disease, because none exists. Here also, we have an opportunity to correct a misunderstanding. If local treatment is successful, we are entitled to believe that the systemic cause is no longer present.

If we make the above-mentioned double check in selecting cases, we shall probably discover dependable evidence of an association with systemic diseases. We already have some indications as to the direction in which we should move in our research. We are all familiar with the gingival hypertrophy of pregnancy, which usually disappears with the delivery of the child. Ziskin showed the connection of the gingivae with the ovaries by experimenting with monkeys. Weinmann studied the specific dynamic value of proteins in cases of diffuse atrophy. Normally, after a breakfast rich in protein, the consumption of oxygen rises from 20 to 40 per cent, returning to normal after a few hours. Weinmann reported that that rise is far lower than the normal in cases of diffuse atrophy, indicating an associated disturbance in function of the hypophysis. Schour, in studying hypophysectomized rats, found resorption of the molar root surfaces and poor cementum deposition. S. C. Miller found an amazingly high percentage of pyorrhea in female patients, indicating a connection with pathosis of the ovaries.

We know the close connection between

the hypophysis and the ovaries. At least, we have several independent indications as to the direction in which we should extend our research work.

We have seen that experimental work coupled with histologic work cannot be considered different from clinical work and observation. It is merely an extension of it. The result of today's research is destined to be an integral part of the practitioner's clinical work of tomorrow.

VINETHENE FOR DENTAL ANESTHESIA

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VINETHENE (divinyl ether) was introduced in 1930 as an anesthetic agent by Leake and Chen.[1] Ruigh and Major[2] prepared the pure drug in 1931. Reports dealing with the early clinical use and the chemical and pharmacologic properties of vinethene have been made by several authors including Knoefel, Guedel and Leake,[3, 4] Gelfan and Bell,[5] Goldschmidt, Ravdin, Lucke, Muller, Johnston and Ruigh,[6] Bourne and Raginsky,[7] Shipway,[8] Killian[9] and Molitor.[10]

Vinethene is about 96.5 per cent pure vinyl ether $(CH_2:Ch)_2O$ and 0.01 per cent phenyl alphanaphthylamine, which prevents polymerization and decomposition, and 3.5 per cent absolute ethyl alcohol, which prevents freezing on evaporation. Vinethene is a clear, almost colorless volatile liquid with a slightly purple fluorescence and a pungent odor. It is about as inflammable and explosive as ether. The inflammable limits in air are from 1.7 to 27.9 per cent and in oxygen from 1.8 to 85.5 per cent. It has a specific gravity of 0.8, a vapor density of the gas of 2.4, and a low boiling point of 28-31° C. (82.4-87.8° F.) and, since it decomposes when exposed to light and air, it must be kept in tightly stoppered dark-glass bottles and generally is not employed after the container has been open for more than twenty-four hours. Adriani[11] has recently suggested that it may be stable for a longer period of time.

During the past few years, additional laboratory and clinical observations dealing with vinethene have been made by numerous authors. A large series of successful administrations of vinethene have been reported for a variety of short surgical procedures.

Since 1936, the use of vinethene analgesia or anesthesia for dental surgical operations has been reported by Saghirian,[12, 13] Gunter, Beach and Looby,[14] Axelrod,[15] Goldman,[16, 17, 18, 19] Ramage,[20] Feldman and Cartin,[21, 22] Roche,[23] Vaile,[24] Harris and Gwathmey,[25] Rosamilia,[26] Lyons and Frank,[27] Cameron,[28] Pinson, Bradbury and Jones,[29] Cartin,[30] French, Hooker, Vanse and Robinson,[31] Seaman,[32] Rothwell,[33] Livingstone, Light, Heidrick and Kable[34] and Macintosh and Pratt.[35] Many of the articles appeared in other than dental journals.

It is the purpose of this communication to present our results with vinethene anesthesia in a series of 312 dental patients.

Operations consisted mainly of simple dental extractions with some instances of

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extraction involving impacted teeth, removal of dental cysts or alveolectomy. There were 160 male and 152 female patients in the series. The age variation was as follows: 11 months, 1; 1 to 9 years, 254; 10 to 19 years, 43; 20 to 29 years, 4; 30 to 39 years, 3; 40 to 49 years, 2; 50 to 59 years, 3; 60 to 69 years, 1, and 70 to 79 years, 1.

The physical state was good in 254 patients, fair in forty-seven and poor in eleven. Preanesthetic complications, in addition to oral sepsis, included the following: congenital heart trouble, 2; hypertension, 2; rheumatic heart disease, 6; bronchial asthma, 2; pulmonary tuberculosis, 3; recent upper respiratory infection, 2; bronchiectasis, lung abscess and bronchiopleural fistula, 1; congenital syphilis, 2; hemorrhagic purpura, 2; marked anemia, 4; history of convulsions, 7; cerebral agenesis, 3; spastic paralysis, 2; flaccid paralysis, 8; other central nervous system diseases, 5; marked obesity, 4; chronic osteomyelitis, 6; gastro-intestinal disease, 11; toxic and high fever, 2; infectious arthritis, 2; mastoiditis, albuminuria, syphilis, marked cervical adenopathy, psychosis, vitamin deficiency and Pott's disease (osteitis of vertebrae), 1 each, and various other infections, 25.

PREOPERATIVE PREPARATION OF PATIENTS

All of the patients had received no fluid or food by mouth for at least six hours before operation. The bladder and rectum had been recently emptied. A physical examination, including at least an examination of the heart and lungs and a urinalysis, was made before anesthetization. Many of the patients had been given more extensive physical examination in the department of internal medicine or of pediatrics.

Premedication was not employed in most patients, and was not found to be essential in most instances. It was also considered inadvisable for patients who were to be ambulatory immediately after operation. In a few apprehensive persons, calcium pentobarbital gm. 0.09 to 0.27, dissolved in from 30 to 50 cc. of water, was administered per rectum. In occasional instances, adults received morphine sulfate gm. 0.010 to 0.015 (h) preferably one hour before anesthesia.

APPARATUS AND METHOD

Open drop ether masks were employed, our choice being a Schimmelbusch, Yankauer or small Ochsner or a plastic mask devised by Arthur E. Guedel. The three former masks were covered with a double thickness of stockinet and on the Guedel mask six or eight layers of gauze were employed. The eyes were protected with a wet cotton pad. Vinethene was dropped from the original container onto the lower two-thirds of the mask, with the bottle near the mask and moving from one area to another to permit rapid vaporization. It was found to be absolutely necessary that a large amount of air be available to the patient at all times. After the stage of surgical anesthesia was reached, the mask was moved until it rested only over the nose, the anesthetist making sure that no pressure was exerted against the external nares. The dropping of vinethene was continued throughout the surgical procedure. Due care was exercised by the anesthetist to keep the chin elevated, to permit adequate oxygenation. The upper air passages were kept patent and free from mucus or blood, and suction was employed whenever indicated. In most instances, the mouth prop was not inserted until consciousness was lost, and then a pack was placed to prevent aspiration.

In some of the patients, maintenance of anesthesia was by means of vaporized vinethene, administered through a previously described vaporizer pinned to the gown of the anesthetist and delivered through a nasopharyngeal catheter.[36]

As with the employment of all other anesthetic agents, an adequate supply of

oxygen, in an apparatus equipped for its efficient administration, as well as an artificial airway must be readily available before the anesthesia is started.

DETAILS OF ADMINISTRATION

The confidence of the patient must be secured by a few carefully chosen words before administration is begun. Children are frequently encouraged to count, the anesthetist assisting with the counting, and the patient usually rapidly becomes unconscious, without any manifestations of excitement. In this series of patients, excitement during induction was observed in six, or 1.9 per cent. With the absence of excitement, very little if any increase in mucus secretion was observed. Nausea and emesis during induction occurred in six (1.9 per cent), excessive mucus secretion in only two and moderate oxygen want in one.

Vinethene administration should be started slowly and the rate of dropping rather rapidly increased to a maintenance rate of 30 to 60 drops per minute. Too abrupt and rapid increase in the rate of administration is usually manifested by irritation of the upper respiratory passages. Individual susceptibility varies as with other anesthetic agents, and since this drug acts with rapidity, it is necessary to observe respiratory and circulatory manifestations almost constantly to judge the depth of anesthesia. Skill and constant observation are essential to the maintenance of an even plane of anesthesia.

The accompanying table gives a summary of a detailed study made on 225 of these patients. The average time for loss of consciousness was 1.37 minutes, with a variation of from thirty seconds to seven minutes. The least vinethene required for loss of consciousness was 2 cc.; the maximum amount, 25 cc. An average of 7 cc. was required for loss of consciousness. Thus, it can be seen that the induction stage was very brief and there was a rapid onset of surgical anesthesia.

In the third stage, the stage of surgical anesthesia, the respirations were full, regular and somewhat increased in rate. Intercostal activity was normal. The pulse was full and regular and the color excellent as long as the upper air passages were not permitted to be obstructed by some mechanical means (position, mucus, etc.). In the first plane, the eyelids may have considerable tonus, but this disappears in the third plane. The pupillary reflex may be inconstant in the first and second planes, but the pupils dilated and the light reflex disappeared in the third and fourth planes in unpremedicated patients. A rhythmic oscillation of the eyeballs usually was present until a deep plane of surgical anesthesia was obtained. Dental work was performed with the eyeballs still oscillating. Jaw relaxation was satisfactory and occurred promptly in all but one instance.

Vinethene must be dropped at a constant and even rate throughout the procedure, since patients rapidly regain consciousness after cessation of adminis-

AGE RANGE, DOSAGE AND TIME FACTORS IN 225 EXTRACTIONS

	Age Years	Total Amount Vinethene Cc.	Total Time Minutes	Amount for Loss of Consciousness Cc.	Time of Loss of Consciousness Minutes
Average	7.7	30.2	9.3	7	1.37
Maximum	44.0	100.0	30.0	25	7.00
Minimum	1.0	5.0	3	2	0.50

tration. Unless something unforeseen occurs, intermittent, uneven administration must be avoided, as such a practice initiates the production of mucus, followed by cyanosis and anoxia. In the rare instance of cyanosis, the anesthetic was immediately withdrawn and a few breaths of oxygen quickly restored the patient to normal.

The patients referred to in the table averaged 7.7 years of age, with a variation from 1 to 44 years. Operative procedures lasted from three to thirty minutes, with an average of 9.3 minutes. These patients required a total of from 5 to 100 cc. of vinethene, with an average of 30.2 cc. Thus, from the column of averages, we can conclude that the average amount of vinethene administered per minute was 3.25 cc., certainly a very small quantity in comparison with the ethyl ether required with the open drop technic.

OVERDOSAGE

Overdosage was not observed in the 312 dental patients and occurred very rarely in our experience in a total of 4,187 vinethene administrations. It is diagnosed by the abolition of upper intercostal activity, and only depressed, irregular, jerky, spasmodic contractions of the lower intercostal muscles and diaphragm are present. Cyanosis and respiratory arrest may quickly follow. Muscular twitching has been observed in a few instances of overdosage. Muscular twitching may also be seen in association with anoxia when an uneven administration has activated mucous secretion and the mucus was not promptly removed from the upper air passages by suction. The treatment consists of immediately removing the anesthetic mask and rapidly securing a patent respiratory tract by the use of suction and an artificial airway followed by the prompt administration of oxygen. If respiration has ceased, it is advisable to combine the rhythmical inflation of the lungs with oxygen with manual artificial respiration. Usually, recovery is prompt and without further incident.

OTHER METHODS

Vinethene may be added to ethylene or nitrous oxide in order to obtain greater relaxation. Its action, when thus employed, is even more rapid, particularly when used in the closed system. Such a method should be employed only by the very experienced anesthetist. We have found vinethene advantageous for extractions in resistant adults when nitrous oxide-oxygen proved inadequate. It is also an excellent induction agent in ether anesthesia. A very smooth transfer to ether anesthesia can be obtained if the anesthetist does not permit any delay in making the change.

We have employed vinethene, alone or in combination with other agents, in a fair series of general surgical patients, including the use of vinethene alone in 661 cases, preceding ether on 3,461 occasions, and in combination with avertin (tribromethyl alcohol), ethylene or nitrous oxide in sixty-five instances; a total of 4,187 administrations.

One of the striking advantages of vinethene anesthesia is the promptness with which consciousness returns, and the minimum of postoperative disturbance. We observed nausea and vomiting during recovery in only eight, or 2.6 per cent, of the dental patients. The only other complication was a brief excitement period observed in an adult and preceding complete return to consciousness. All patients became rational very quickly and could have been ambulatory almost at once, but it was thought best to allow them a thirty-minute rest in an adjoining room before discharge. Some were returned to their hospital beds, while the majority were discharged in thirty minutes, and seen at a later date in the outpatient department for their subsequent examination. There were no other postoperative complications.

The contraindications for vinethene thus far more generally agreed upon are particularly: known or suspected hepatic damage; operations lasting over thirty minutes; the presence of a flame or sparking device; anuria, uremia or marked disease of the kidneys; paralysis of the vocal cords; ankylosis of the jaws; goiter; extensive disease of the lungs; diabetes; cyanosis; intestinal obstruction, and advanced debility.

DISCUSSION

If local anesthesia will not be adequate, as in the presence of a general or local infective process in the mouth, multiple extraction from the various quadrants of the mouth, fracture of the jaw and a refractory or uncooperative attitude of the patient, particularly the young child who, very frequently, is uncooperative and may not take gas smoothly, we have found vinethene to be very satisfactory. We have avoided its use in operations lasting more than thirty minutes because of pathologic changes that may occur when it is employed for longer periods of time.[6, 37]

The physical signs of vinethene anesthesia are typical. This agent should be employed only by anesthetists with adequate knowledge of and experience in interpreting these signs and in treating overdosage.

Vinethene can also be used to advantage in minor war surgery.[33, 35, 39] The convenience and simplicity of its administration by the open drop technic, the rapidity of induction and recovery with a minimum of associated nausea and vomiting, the absence of anoxia and the rapid return to a clear mental state should make it a definite asset in war surgery.

Vinethene analgesia, as described by Lyons and Frank,[27] no doubt has a definite place in dentistry. We have been pleased with the results in using this method on a small series of patients, and feel that it deserves further investigation.

BIBLIOGRAPHY

1. LEAKE, C. D., and CHEN, M. Y.: Anesthetic Properties of Certain Unsaturated Ethers. *Proc. Soc. Exper. Biol. & Med.*, 28: 151, November 1930.

2. RUIGH, W. L., and MAJOR, R. T.: Preparation and Properties of Pure Divinyl Ether. *J. Am. Chem. Soc.*, 53:2662, 1931.

3. KNOEFEL, P. K.; GUEDEL, A. E., and LEAKE, C. D.: Experimental Observations on Anesthetic Properties of Divinyl Ether. *Proc. Soc. Exper. Biol. & Med.*, 29:139, November 1931.

4. *Idem:* Anesthetic Action of Divinyl Oxide in Animals. *J. Pharmacol. & Exper. Therap.*, 47:5, January 1933.

5. GELFAN, S., and BELL, I. R.: Anesthetic Action of Divinyl Oxide on Humans. *J. Pharmacol. & Exper. Therap.*, 47:1, January 1933.

6. GOLDSCHMIDT, S., *et al.:* Divinyl Ether. *J.A.M.A.*, 102:21, January 6, 1934.

7. BOURNE, W., and RAGINSKY, B. B.: Vinyl Ether (Vinethene) Anesthesia in Dogs—Effects upon Normal and Impaired Liver. *Brit. J. Anaesth.*, 12:62-69, January 1935.

8. SHIPWAY, F. E.: Vinethene. *Brit. M. J.*: 1:70, January 12, 1935.

9. KILLIAN, H.: Der neue Divinyläther (Vinethen). *Chirurg*, 7:433-444, July 1, 1935.

10. MOLITOR, H.: Some Pharmacological and Toxicological Properties of Vinyl Ether. *J. Pharmacol. & Exper. Therap.*, 57:274, July 1936.

11. ADRIANI, J.: Stability of Vinyl Ether (Vinethene). *Anesthesiology*, 2:191-193, March 1941.

12. SAGHIRIAN, L. M.: Vinyl Ether (Vinethene) Inhalation Anesthetic—Clinical Use in Oral Surgery. *D. Cosmos*, 78:531, May 1936.

13. *Idem:* Vinyl Ether (Vinethene). Its Use and Application in Surgery of Mouth. *Cur. Res. Anesth. & Analg.*, 18:10, January-February 1939.

14. GUNTER, J. H.; BEACH, E. W., and LOOBY, J. P.: Use of Vinyl Ether as Dental Anesthetic. *Internat. J. Orthodontia*, 22:746, July 1936.

15. AXELROD, M. L.: Scope and Utility of Some Newer Anesthetics in Dentistry and Oral Surgery. *Cur. Res. Anesth. & Analg.*, 15:237, September-October 1936.

16. GOLDMAN, V.: Dental Anaesthesia for Children with Special Reference to Vinyl Ether. *D. Delineator*, 3:8, November 1936.

17. *Idem:* Vinyl Ether for Dental Anaesthesia. *Proc. Roy. Soc. Med.*, 30:891 (Sect. Odontol.), January 25, 1937.

18. *Idem:* Vinyl Ether for Minor Surgery

and Dentistry. *Post-Grad. M. J.*, 15:58, February 1939.

19. *Idem:* Dental Anaesthesia in Children. *Brit. M. J.*, 1:588, April 6, 1940.

20. RAMAGE, G.: Vinyl Ether Anesthesia in County Dental Clinics. *D. Rec.*, 57:137, March 1937.

21. FELDMAN, M. H., and CARTIN, S.: Administration and Use of Vinethene in Dentistry. *D. Outlook*, 24:504, November 1937.

22. FELDMAN, M. H., and CARTIN, S.: Vinyl Ether (Vinethene) for Dental Surgery: Report on Experiences with Five Hundred Cases. J.A.D.A., 25:616, April 1938.

23. ROCHE, L. S. C.: Dental Extractions in Children Under Vinyl Ether. *J. Roy. Army M. Corps*, 69:399, December 1937.

24. VAILE, T. B.: Anaesthesia in Dentistry. *Practitioner*, 140:264, March 1938.

25. HARRIS, LEON, and GWATHMEY, J. T.: General Anesthesia in Dental Practice. *D. Outlook*, 25:306, July 1938.

26. ROSAMILIA, P. A.: Vinethene—Its Use in Dental Office: Study of One Hundred Cases. J.A.D.A., 25:1465, September 1938.

27. LYONS, S. S., and FRANK, H. P.: Vinethene Analgesia: Technic for Dental Extractions in Ambulatory Clinics. J.A.D.A., 26: 580, April 1939.

28. CAMERON, J. R.: Selecting Suitable Anesthetic Agent for Exodontia and Oral Surgery. *Cur. Res. Anesth. & Analg.*, 18: 278, September-October 1939.

29. PINSON, K. B.; BRADBURY, R., and JONES, E. B.: Improved Method of Administration of Vinethene in Dental Surgery. *Brit. M. J.*, 2:729, October 7, 1939.

30. CARTIN, S.: Scope and Utility of Vinethene Anesthesia in Dentistry and Oral Surgery. *Cur. Res. Anesth. & Analg.*, 18:324, November-December 1939.

31. FRENCH, J. O., *et al.:* Dental Anaesthesia in Children—Comparison of Vinyl Ether and Ethyl Chloride in Series of 200 Cases. *Brit. M. J.*, 1:432, March 16, 1940.

32. SEEMAN, G. F.: Vinethene and Ethyl Chloride as Synergistic Agents with Nitrous Oxide Oxygen Anesthesia in Dental and Oral Surgery. *Cur. Res. Anesth. & Analg.*, 19:95, March-April 1940.

33. ROTHWELL, B. C.: Vinethene, Inhalation Anesthetic for Rapid Induction and Quick Recovery, Administered by Open Drop or in Gas Machine for Dental Oral Surgery. *Mil. Surgeon*, 86:452, May 1940.

34. LIVINGSTONE, H. M., *et al.:* Further Experience with Divinyl Ether (Vinethene) Anesthesia. *J.A.M.A.*, 115:1353, October 19, 1940.

35. MACINTOSH, R. R., and PRATT, F. B.: Essentials of General Anesthesia. Oxford: Blackwell Ltd., 1940.

36. LIVINGSTONE, H. M., and HICKMAN, JANE: Apparatus for Administration of Divinyl Ether (Vinethene) Vapor. *Cur. Res. Anesth. & Analg.*, 17:91 (Suppl.), July-August 1938.

37. ORTH, O. S., *et al.:* Studies of Vinethene as Anesthetic Agent. *Anesthesiology*, 1:246-260, November 1940.

38. MACINTOSH, R. R., and PRATT, F. B.: Anaesthesia in War Time. *Brit. M. J.*, 2: 1077-1079, December 2, 1939.

39. OGUS, W. I.: Vinethene. Suitable Anesthetic for War Surgery. *Mil. Surgeon*, 88: 301-306, March 1941.

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THE EVALUATION OF RADIODONTIC SERVICE IN DIAGNOSIS

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IN appraising the value of radiodontic service, it is pertinent that, in contrast with merely making indifferent radiographs and forming impulsive conclusions, adequate radiodontic service be defined. Since the purpose of a radiodontic examination is to supply information, the evidence must be as definite and comprehensive as can be obtained by the process. The technical essentials in film placement and retention, in angulation, in penetration and exposure, in immobility and in development must be sufficient to render distinct images of the structures with approximate anatomic accuracy. These concise technical requirements are difficult to master and are not generally attained. Too often, distortion, superimposition or a lack of definition of the images or incorrect exposure and development obscure the evidence.

Correct interpretation of the evidence is also an essential of adequate radiodontic service. In addition to learning the principles of interpretation, extensive observation of anatomic variations and the different manifestations of disease are necessary. Radiodontic practice has been systematized as have other branches of dentistry, and the details are as definite and exacting as in other complex operations. They can be acquired by any competent dentist, but only by earnest study. First, a sound technical procedure should be memorized. Then intensive practice is necessary to become adept in manipulation and to develop perception in calculating angulation. Practice does not make perfection unless correct methods are practiced, but makes the errors more difficult to overcome. A dentist may use an x-ray machine for years without recognizing the technical essentials or making radiographs that serve his needs.

The importance of radiodontic service is obvious when it is compared with other means of securing diagnostic information. The most generally used examination is a combination of ocular aids, mirror and explorer. It is effective in revealing most caries of the visible surfaces of the teeth, but only advanced caries that has produced discoloration or an explorable opening in the approximal surfaces. The extent of periodontal lesions can be determined by probing, but the remaining support of the teeth can only be surmised by the mobility, which is not always reliable.

Palpation locates and, to some degree, differentiates the character of swollen areas and aids in the diagnosis of bone fractures. It demonstrates suppuration in gingival pockets, and shows the mobility of teeth without distinguishing between impaired attachment and loss of supporting bone. Percussion, which is especially useful in diagnosing periapical inflammation, may be the first evidence of septic degeneration of a pulp. When percussion is applied with a mouth mirror or an instrument handle, the tone emanating from different teeth is indicative of the strength of their support.

Vitality tests are often indispensable aids in the diagnosis of pulp conditions, although there are limitations to their utility. Otherwise normal pulps which

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have receded may not respond, and septic pulps that are the source of periapical involvement may retain sufficient vitality to give a positive response. When in doubt, both electric and thermal tests should be employed. The most decisive test is that of a pulp in an advanced stage of degeneration, when heat intensifies the pain and cold gives immediate relief.

Transillumination discloses congestion of the gums, but not disease in bones, until an extensive area is destroyed. It will reveal caries of the approximal surfaces of teeth, when there is sufficient decalcification and discoloration to produce an area of opacity. Transillumination of maxillary sinuses does not discriminate between anatomic and pathologic variations.

Symptoms and history are often invaluable in establishing a diagnosis, but, without other evidence, they may be deceptive. The susceptibility of the trifacial nerves to reflex pain may render the subjective symptoms unreliable for locating the source of the disturbance. It is almost characteristic that the patient is either in doubt whether the pain is from the maxillae or from the mandible or is mistaken in the location. Caries usually does not develop subjective symptoms soon enough to give adequate warning, and generally chronic periodontal and periapical infection are locally symptomless.

Radiodontic service will provide nearly all the diagnostic data of the other available means of examination and will give much additional information. Also, it is needed to amplify or to correct the evidence of other examinations. For examination of unerupted teeth, there is no acceptable substitute for radiodontia. Particularly in orthodontic diagnosis, it is necessary to establish the presence or absence of unerupted teeth, including supernumeraries. Radiographs not only supply this information, but also show the location and position of these teeth. Even in the apparently edentulous alveolar process, unerupted teeth, root fragments or septic crypts may be found.

In a thorough inspection for caries, bitewing radiographs of the bicuspids and molars save time and labor by immediately revealing a maximum of forty approximal surfaces which are inaccessible. In some of these surfaces, carious destruction may be obvious; others are conclusively caries free, and some may be questionable. Then the explorer examination can be limited to the questionable approximal surfaces, the accessible margins of restorations and the occlusal pits and fissures. Radiographs generally do not show caries in pits and fissures until the dentin is invaded, but they do register caries beginning at the dentino-enamel juncture of fissures that cannot be explored. Leaks at the margins of restorations may not be visible in radiographs until considerable destruction has occurred, but, in other instances, decalcification is visible around restorations from leaks that are not explorable.

The first evidence of periodontal lesions is revealed in radiographs as a disintegration of the alveolar crest, and often years before there are other diagnostic features. Radiographs disclose not only the extent of periodontal destruction, but also the amount and character of the alveolar support remaining as a basis for the method of treatment and prognosis.

In discovering the cause of pain and swelling of obscure origin, radiodontic service is a boon to patients and to dentists. When patients seek relief from a severe disturbance, they expect dentists to find the cause, which may be difficult. Pulpitis is the most common cause of toothache and often the most difficult to detect. Radiographs, by revealing or excluding obscure caries and incipient periapical infection, promote prompt diagnosis. Swelling is usually the result of an acute periapical abscess or an infected periodontal pocket, either of which can be detected radiographically.

The most publicized feature of radiodontic service is its use in the search for septic foci. The majority of the laity and many dentists still believe that this is the principal purpose of a radiodontic examination, but preventing sepsis of the teeth is more important. Chronic periapical infections are nearly always painless and without external indications of their existence. Radiography is the only means of discriminating between harmless pulpless teeth and pathogenic teeth.

Maxillary and mandibular fractures cannot be diagnosed so well by any other means as by radiographic examination. The location and extent of fractures and the displacement of fragments must be ascertained before deciding upon treatment. Dentists in war service have extraordinary demands for the diagnosis and treatment of fractures and for the localization and removal of foreign bodies in the face and jaws. They must be familiar with the methods of localization, and regardless of who makes the radiographs, they must be able to interpret them. This evaluation of radiodontic service is based upon requisite skill in making the examinations, and sufficient knowledge and experience to interpret the evidence.

A PROFESSIONAL SAVINGS PLAN LEADING TOWARD NATIONAL VICTORY AND PERSONAL SECURITY

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ONE of the phases of good practice management is the establishment of a financial program which would permit complete retirement at an advanced age. This would contribute much to peace of mind and security during postwar years.

Because of the nature of his profession, the dental practitioner should not speculate either in real estate or upon stock market fluctuations. Trading in these fields must be left to experts in complex financial transactions, which involve not only theoretical knowledge and background, but also a certain amount of legal acumen.

The present war financing of our government offers the professional man an excellent opportunity to serve his country patriotically and to protect his capital funds during a proposed twenty-five years of practice effort.

The E bonds of our government return $4 for approximately every $3 invested; and if this in turn is reinvested as the maturity of each bond is reached, it will provide a nice nest egg later on. The accompanying table indicates this possibility. If the doctor is 40 when he starts this plan and purchases $750 worth of bonds a year, at the end of ten years he will have a $1000 bond maturing each year, to which he should add $875 a year, reinvesting the total amount for the next ten-year period. This is an increase of $125 a year, or approximately $10 a month. During the remaining years, which are now five, the doctor will have $2500 worth of bond maturing each year, to which it is recommended that he add $500 from current earnings for the purpose of making his final purchases, according to the schedule in the table.

At the age of 65, if purchases cease altogether, he will have $2500 worth of bonds maturing each year until he is

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70, and $4000 worth of bonds maturing each year until his seventy-fifth year.

During the years of the operation of the plan, a total investment from earned income of $18,750 will have been made. The potential reserve in the years following proposed retirement at the age of 65, will total $32,500.

If his expenditures are limited to $2500 a year, he will have provided himself with an insurance protection of his own making, which is far beyond the usual life expectancy period.

Especially for those who at the present find themselves uninsurable is this plan recommended. For the average man, moderate amounts of insurance and the ownership of his own home will round out a program, the completion of which earns much satisfaction for a useful life. This plan can be modified or enlarged upon a proportional basis to meet any particular set of circumstances, but the suggestion is here made that the minimum objective be guaranteed with the possibility of bettering the accomplishment whenever possible.

9400 Euclid Avenue.

SAVINGS PLAN

No. of Years for Plan to Operate	No. of Bonds Purchased in 1000 Mat. Value	Each Year Purchase Bonds of This Amt.	Age of Doctor at Time of Purchase	Age of Doctor at Maturity	Value of Bonds at Maturity
1	1	750	40		
2	1	750	41		
3	1	750	42		
4	1	750	43		
5	1	750	44		
6	1	750	45		
7	1	750	46		
8	1	750	47		
9	1	750	48		
10	1	750	49		
11	2½	1875	50	50	1000
12	2½	1875	51	51	1000
13	2½	1875	52	52	1000
14	2½	1875	53	53	1000
15	2½	1875	54	54	1000
16	2½	1875	55	55	1000
17	2½	1875	56	56	1000
18	2½	1875	57	57	1000
19	2½	1875	58	58	1000
20	2½	1875	59	59	1000
21	4	3000	60	60	2500
22	4	3000	61	61	2500
23	4	3000	62	62	2500
24	4	3000	63	63	2500
25	4	3000	64	64	2500
				65	2500
				66	2500
				67	2500
				68	2500
				69	2500
				70	4000
				71	4000
				72	4000
				73	4000
				74	4000

IN VITRO STUDIES ON STERILIZATION OF CARIOUS DENTIN. I. EVALUATION OF GERMICIDES

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THIS is a report on experiments that were designed to evaluate various germicides for the sterilization of carious dentin.* While there is some question as to the necessity or advantage of sterilizing all cavities after preparation and prior to filling, under certain conditions such sterilization may be of great importance. Thus, in order to restore successfully deep carious lesions where pulpal degeneration has not already begun, it is necessary to prevent pulp infection as well as chemical and physical injuries. Such infection may result either from extension of the carious process, if carious dentin is left in the cavity, or from exposure of the pulp in an attempt to remove all of the carious dentin. These sequelae could be avoided if it were possible to sterilize carious dentin without pulpal injury, for it would then be permissible to leave a sterile albeit decalcified layer of dentin to protect the pulp.

This idea is not new. Several investigators have suggested that leaving a small amount of carious dentin is preferable to exposing the pulp.[1, 2, 3, 4] However, there is no agreement on the value of this procedure because of the controversy as to the efficacy of the various germicides commonly used to sterilize cavities after preparation. Since the work of Howe,[1] ammoniacal silver nitrate has been most frequently recommended for sterilizing carious dentin left in a cavity. Because it produces discoloration, its use has been restricted largely to treatment of the posterior teeth, but it has been used in treating caries of anterior teeth.[3] Other agents that have been used in the treatment of deep caries are neutral acriflavine,[2] copper sulfate and zinc sulfate,[5] chloramine-T[6] and the essential oils.[7] In all of these studies, the choice has been based on uncontrolled clinical experience. Since W. D. Miller's work in 1891,[8] few controlled laboratory experiments have been performed to evaluate the various germicides commonly used for cavity sterilization. Miller[8] compared the efficacy of nineteen different germicides in sterilizing carious dentin remaining in extracted teeth and also their ability to penetrate through decalcified dentin. He found that water-soluble substances such as iodine trichloride, mercury bichloride and hydrogen peroxide were most efficacious; that phenols in general were poor penetrating agents, and that essential oils such as the oils of cinnamon, peppermint and clove were worthless. He also pointed out that the length of time that any agent is applied is of vital importance, a fact too frequently overlooked.

Barker,[4] using artificially infected cubes of dentin, found that silver nitrate

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*This study was suggested by Capt. J. A. Tartre (DC), United States Navy, who furnished the clinical material. The treatment of deep carious lesions is an important problem in the Navy since the present inadequate treatments frequently require that teeth be extracted. When teeth with such lesions are restored, "flareups" may result.

was most effective, phenol less effective and acriflavine ineffective. Recently, Seltzer[9, 10, 11] studied the ability of various germicides to sterilize cavities prepared *in situ*. He applied the various agents to the hard, undecalcified dentin remaining after all decay had been removed. His results are considerably at variance with those of former investigators.

From this brief review of past attempts to sterilize carious dentin, it is apparent that no reliable criteria are available to evaluate germicidal agents. Standard phenol coefficients tell us nothing as to the penetrating ability of a given germicide. Consequently, it was necessary to devise an *in vitro* technic for studying both the penetration and the antibacterial activity of various germicides when applied to carious dentin. The method finally chosen utilizes small blocks of carious dentin of known dimensions treated under standard conditions, as will be described.

STERILIZATION OF BLOCKS OF CARIOUS DENTIN

Moist carious teeth with a considerable amount of firm carious dentin were washed with a stream of water under pressure to remove all loose débris. The carious dentin was then removed in one piece and cut with a razor blade into cubes or rectangular prisms, from 0.8 to 1.0 mm. and from 1.1 to 1.4 mm. thick. Immediately after preparation, they were put into a moist chamber to prevent drying.

The carious dentin from one tooth furnished a series of pieces which were roughly of the same dimensions. Each piece was immersed for three minutes in the germicide to be tested, removed and

TABLE 1.—STERILIZATION OF CARIOUS DENTIN WITH VARIOUS GERMICIDAL AGENTS

Carious Dentin Samples	Germicide	Bacterial Growth After		
		24 Hours	48 Hours	72 Hours
Series 1 Dentin cut into pieces from 1.1 to 1.3 mm. thick	None (untreated control)	+	+	+
	*Silver nitrate (saturated)	—	—	—
	Ethyl alcohol (70 per cent)	+	+	+
	Iodine (10 per cent)	—	+	+
	*Hydrogen peroxide (30 per cent)	—	—	—
	Chloramine-T (saturated)	?	+	+
Series 2 Dentin cut into pieces from 1.3 to 1.5 mm. thick	None (untreated control)	+	+	+
	Silver nitrate (saturated)	?	+	+
	Ethyl alcohol (70 per cent)	+	+	+
	Iodine (10 per cent)	?	+	+
	Hydrogen peroxide (30 per cent)	—	+	+
	Chloramine-T (saturated)	+	+	+
Series 3 Dentin cut into pieces from 1 to 1.2 mm. thick	None (untreated control)	+	+	+
	*Silver nitrate (saturated)	—	—	—
	Ethyl alcohol (70 per cent)	+	+	+
	Iodine (10 per cent)	?	+	+
	*Hydrogen peroxide (30 per cent)	—	—	—
	Chloramine-T (saturated)	—	+	+

*Gram stains and subcultures made at the end of three days were likewise negative.

washed with 10 cc. of sterile distilled water applied dropwise from a sterile pipet. The piece of dentin was ground in a sterile mortar with 0.3 cc. of culture medium and a tube of culture medium inoculated with the entire sample.† In this way, a series of similar pieces of carious dentin could be treated with a variety of germicides and the relative ability of these germicides to sterilize the pieces determined.

The data from a typical experiment are shown in Table 1. Inoculated tubes were examined visually for growth every day for three days. At the end of this period, all tubes showing no growth were subcultured, to rule out the possibility of bacteriostasis. All the cultures were checked by Gram's stain, although no attempt was made to isolate or identify the bacteria present. It was concluded that sterilization of the dentin had been achieved if there was no growth in the culture tube and if the subcultures and gram-stained smears were negative.

A number of tests were made to determine whether the silver nitrate treated samples had any bacteriostatic effect in the medium which was inoculated with them. In no case was such an effect observed. To eliminate the possibility that silver nitrate, in the cases wherein this compound was tested, exerted its germicidal effect during the grinding process, the samples treated with this germicide were ground in media containing a small amount of sodium sul-

TABLE 2.—GERMICIDES TESTED FOR THEIR ABILITY TO PENETRATE AND STERILIZE CARIOUS DENTIN

Group	Germicide	Concentration
Metallic salts	Silver nitrate*	Approx. 9.6 molar#
	Cupric nitrate	Approx. 5.7 molar
	Cadmium nitrate	Approx. 5.4 molar
	Mercury bichloride	Approx. 0.3 molar
	Merthiolate	Approx. 2.0 molar
Oxidizing antiseptics and halogen containing compounds	Hydrogen peroxide*	30 per cent solution
	Iodine	10 per cent I_2 in 10 per cent potassium iodide
	Chloramine-T	14 per cent solution
Phenols	Liquid phenol	90 per cent concentration
	Beechwood creosote	Mallinckrodt's USP
Organic dyes	Neutral acriflavine	20 per cent solution
	Neutral acriflavine with tyrothricin	20 per cent acriflavin 0.2 per cent tyrothricin
Surface active compounds (cationic detergents)	Zephiran†	Approx. 20 per cent solution
	Phemerol‡	Approx. 10 per cent solution
Miscellaneous compounds	Ethyl alcohol	70 per cent by weight
	Urea	Saturated solution

*These were the only compounds that were able to sterilize carious dentin under the conditions described.

†Alkyl dimethyl benzyl ammonium chloride.

‡p-tertiary octyl phenyl diethoxydimethyl benzyl ammonium chloride.

#A molar solution contains 1 gram molecular weight of substance per liter of solution.

†The medium selected was a modified Rosenow's (semi-solid beef heart infusion containing a piece of brain) prepared according to Herbert P. Steinmeyer (Master's thesis, University of Chicago 1943). Experiments have shown it to be superior to the followng types of media: Brewer's thioglycollate, Jay's broth, blood-agar-dextrose plates, dextrose-veal infusion medium and ascitic agar medium.

fide, which immediately converts free silver ions to silver sulfide, a substance with no germicidal properties.

By our method, we obtain only an all or none effect. There may be differences in the germicidal activity of compounds that consistently fail to give complete sterilization. Thus the results in Table 1 indicate that treatment with iodine has materially reduced the number of bacteria since definite growth was never observed within twenty-four hours; yet, in three days, the samples treated with iodine grew consistently.

It must be kept in mind that when a piece of carious dentin from 0.8 to 1.4 mm. thick is sterilized, it cannot be concluded that the agent used has completely penetrated that piece. These experiments tell us nothing about the depth to which the dentin is infected. However, when a number of germicides are tested on similar pieces cut from the same carious tooth and one of these agents sterilizes, that compound must have penetrated to a greater depth than the others.

On this comparative basis, saturated silver nitrate proved to be the best germicide of the sixteen that were tested. Table 2 lists the germicides that were tested and the concentration in which they were applied. They were selected to include typical members of the following groups: metallic salts, oxidizing agents, halogens, phenols, organic dyes and cationic detergents. In general, the most concentrated solution feasible was employed. Of the compounds tested, only saturated silver nitrate‡ and 30 per cent hydrogen peroxide (superoxol) were able to sterilize pieces of carious dentin from 0.8 to 1.4 mm. thick, but they did not sterilize in every case. The relative germicidal activity of these two compounds is summarized in Table 3.

In similar experiments, it was found that decreasing the time of exposure or lowering the concentration of silver nitrate decreased the efficiency of sterilization.

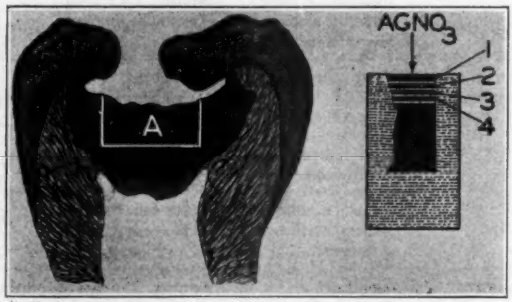

Fig. 1.—Schematic drawing of tooth with extensive carious dentin from which block A is cut. It is then embedded in paraffin. Silver nitrate is applied as shown and slices 1, 2, 3 and 4 are cut, 0.25 mm. thick, after excess reagent is washed off.

RELATIONSHIP OF DEPTH OF PENETRATION OF SILVER NITRATE TO STERILIZATION OF CARIOUS DENTIN

In view of the ability of silver nitrate to sterilize pieces of carious dentin, it seemed desirable to determine more ac-

‡A series of preliminary experiments showed that ammoniacal silver nitrate had no advantages over saturated aqueous silver nitrate when applied to pieces of carious dentin *in vitro*. Results obtained with ammoniacal silver nitrate may be complicated by the relatively high alkalinity of this solution and by the possible presence of free ammonium hydroxide. Hence, the aqueous solution was chosen.

curately the concentration necessary for sterilization. For this purpose, we again selected teeth with extensive leathery decay. Such a tooth is shown in Figure 1. As illustrated in this figure, a large rectangular block of carious dentin was cut and embedded in a low-temperature-melting paraffin (40° C.) in such a manner that the superficial, uniformly infected surface lies in a vertical plane. Embedded in this way, the dentin can be cut with a microtome into sections of known thickness. In order to test the penetration of silver nitrate into such a piece of carious dentin, experiments were performed as follows: The paraffin block was cut so as to expose the dentin. To this surface, saturated silver nitrate was applied for three minutes and, in later experiments, for ten minutes. Excess silver nitrate was washed away with 30 cc. of sterile distilled water. Sections of dentin 0.25 mm. thick were then cut in the microtome, using a sterile knife. They were divided into two equal parts, and one part was cultured for bacteria in the manner previously described. The other part was trimmed with a razor blade so as to give a rectangular block the dimensions of which could be ac-

TABLE 3.—STERILIZATION OF PIECES OF CARIOUS DENTIN

Germicide (Concentration)	1.1 to 1.5 mm. Pieces		0.8 to 1 mm. Pieces	
	Total Number Tested	Samples Sterilized Per Cent	Total Number Tested	Samples Sterilized Per Cent
Silver nitrate (saturated solution)	36	64	19	84
Hydrogen peroxide (30 per cent solution)	19	42	9	55

TABLE 4.—PENETRATION OF SILVER NITRATE INTO CARIOUS DENTIN IN RELATION TO ITS GERMICIDAL ACTIVITY*

Experiment	Slice I		Slice II		Slice III		Slice IV	
	Silver Content	Bacteria	Silver Content	Bacteria	Silver Content	Bacteria	Silver Content	Bacteria
1	228	—	88	—	64	+	56	+
2	163	—	94	—	37	+	30	+
3	245	—	96	+	23	+	11	+
4	220	—	79	—	40	+	11	+
5	384	—	98	+	84	+	64	+
6	232	—	66	+	31	+	9	+
7	205	—	62	—	51	+	12	+
8	260	—	94	+	71	+	38	+
9	239	—	93	+	66	+	45	+
10	224	—	53	—	14	+	4	+
11	205	—	47	+	7	+	3	+
12	198	—	58	—	45	+	26	+
13	145	—	75	—	71	+	24	+
14	186	—	49	+	10	+	0	+
15	324	—	132	+	55	+	24	+
Averages	230	—	79	8+ 7—	44	+	24	+

*Saturated silver nitrate applied for three minutes. The silver content is given in terms of silver ion (Ag+) as parts of silver per thousand parts of dentin.

curately determined. This block was analyzed for its silver content by a modification of the ultramicro-method of Bouilloux.[12] The method as applied measures the total silver content; i.e., inorganic silver plus organically combined silver.

A summary of fifteen such experiments is given in Table 4. It can be seen that the first slice was uniformly sterilized and the average silver content of this slice was 230 parts of silver per thousand parts of dentin. The second slice was sterilized in 50 per cent of the cases and the average silver content was 70 parts of silver per thousand parts of dentin. In no case was the third or fourth slice sterilized. The silver content of these averaged 44 and 24 parts per thousand parts of dentin respectively. The variation in silver content of slices obtained in different experiments, but taken at the same level, i.e. slice 1, slice 2, etc., may be ascribed to variations in the degree of decalcification. When silver nitrate comes in contact with an incompletely decalcified spot in the dentin, silver phosphate is precipitated and penetration is retarded. The presence of such partially decalcified areas can be shown by a staining technic. The slices as they are cut in the microtome may be immersed in a dilute solution of ascorbic acid, which will reduce the silver to a black deposit of metallic silver. Beyond the third slice, i.e., at depths greater than 0.75 mm., irregularity of penetration is shown by the uneven staining. Such stained sections are shown in Figure 2, serial sections cut from two different pieces of dentin. Although both pieces were composed of leathery dentin which

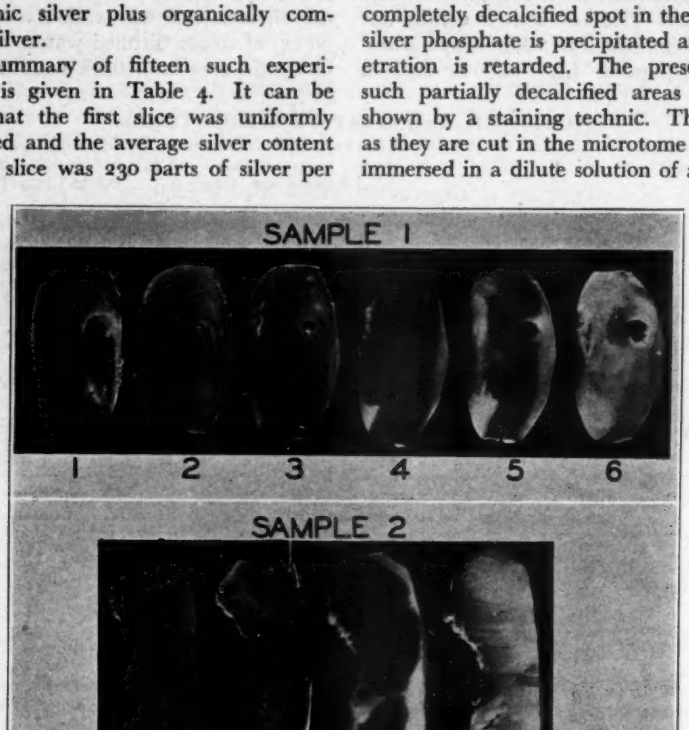

Fig. 2.—Microphotograph illustrating extent of penetration of saturated silver into carious dentin. Sections cut from sample 1 begin to show uneven staining at slice 4 (1 mm.) level, while sections cut from sample 2 show uneven staining at slice 2 (0.5 mm.) level.

could be cut by the microtome and were treated with saturated silver nitrate for three minutes, there is a marked difference in the depth of penetration.

It is apparent from Table 4 that a three-minute application of saturated silver nitrate solution does not consistently sterilize to a depth of more than 0.25 mm. of carious dentin. Since the time for which a solution is applied is an important factor in determining the depth to which it will penetrate, it seemed desirable to establish whether the depth of sterilization could be increased by extending the time of application to ten minutes. Table 5 summarizes the results of eleven such experiments. Again, only the first 0.25 mm. were sterilized in every case, but now most of the samples down to 0.75 mm. (i.e., slices 2 and 3) were rendered sterile. At the 1.0 mm. level (slice 4), sterilization was achieved less frequently. Paralleling the increased depth of sterilization was an increase in the average silver content of all the slices, particularly in the deeper layers. It is reasonable to expect that a somewhat greater penetration could be achieved if the silver nitrate were applied to carious dentin left in a tooth. In the foregoing experiments, silver nitrate must penetrate across the original dentinal tubules. When applied *in situ*, it would penetrate with the tubules. Furthermore, with this method of embedding the carious dentin, any incompletely decalcified spicule extending from the region over the pulp toward the occlusal surface would decrease the penetration.

DISCUSSION

The experiments with the small pieces of carious dentin show that very few of the commonly used germicides can be relied upon to penetrate and sterilize any appreciable amount of carious dentin even though the concentration of germicide and length of time of application are at a practicable maximum. Confirming the pioneer work of W. D. Miller,[8] we have found that compounds readily soluble in water are superior to those which are not so soluble. Yet this cannot be the only factor since copper nitrate, although it is quite soluble (Table 2), proved to be definitely inferior to silver nitrate.

TABLE 5.—PENETRATION OF SILVER NITRATE INTO CARIOUS DENTIN IN RELATION TO ITS GERMICIDAL ACTIVITY*

Experiment	Slice I		Slice II		Slice III		Slice IV	
	Silver Content	Bacteria	Silver Content	Bacteria	Silver Content	Bacteria	Silver Content	Bacteria
1	259	—	195	—	125	+	82	+
2	349	—	193	—	84	—	52	—
3	363	—	211	—	107	—	50	+
4	291	—	141	+	50	+	25	+
5	244	—	213	—	123	—	64	—
6	349	—	172	+	101	+	32	+
7	240	—	187	—	117	—	29	+
8	237	—	128	—	68	—	7	+
9	339	—	171	—	134	—	49	+
10	172	—	112	—	113	—	80	—
11	257	—	180	—	150	—	114	—
Averages	282	—	173	2+ 9—	106	3+ 8—	53	7+ 4—

*Saturated silver nitrate applied for ten minutes. The silver content is expressed in terms of silver ion (Ag+) as parts of silver per thousand parts of dentin.

It would be erroneous to conclude that any of the compounds tested and found unable to sterilize such pieces of carious dentin as we used would be equally ineffective for sterilizing the surface of sound dentin after the usual type of cavity preparation. We know, for example, that the cationic detergents are good surface sterilizing agents. However, these experiments were designed with the problem of the near-exposure of the pulp in mind. When a carious floor of dentin is left in order to prevent pulp exposure, a germicide must be employed that can be relied upon to give more than surface sterilization.

Although silver nitrate penetrates carious dentin effectively, it must be applied for a sufficient length of time to attain a germicidal concentration in the carious mass. Heretofore, the depth of penetration of this agent has always been studied by histologic technics. Such methods give erroneous results, since, in carious dentin, the depth of penetration is greater than the depth of sterilization. Thus, after a three-minute application, we uniformly found silver 1 mm. from the surface to which it was applied.

The retarding effect of incomplete decalcification of the dentin confirms the observations of Howe and Prime[1, 3] that silver nitrate penetrates sound dentin slightly, if at all. Thus, a small amount of secondary dentin would largely prevent an appreciable amount of silver from reaching the pulp tissues.

SUMMARY

1. Of sixteen germicides tested, only saturated silver nitrate and hydrogen peroxide (30 per cent) sterilized cubes of carious dentin from 0.8 to 1.5 mm. thick.

2. Regarding the relation between the depth of penetration and the depth of sterilization by silver nitrate, it was found that a three-minute application uniformly sterilized at least 0.25 mm. of carious dentin and that the average silver concentration required to do this is 230 parts of silver per thousand parts of dentin. In approximately half of the experiments, a three-minute application sterilized to a depth of 0.5 mm.

In ten minutes' application, the depth of sterilization was increased to 0.75 mm. in most cases, and, at this depth, the average silver content was 106 parts of silver per thousand parts of dentin. At greater depths, sterilization resulted less frequently, although the average silver content was 53 parts of silver per thousand parts of dentin.

BIBLIOGRAPHY

1. HOWE, P. R.: Method of Sterilizing, and at Same Time Impregnating with Metal, Affected Dentinal Tissue. *D. Cosmos,* 59: 891, September 1917.

2. WAAS, M. J.: Medicament Free from Caustic Effects for Sterilization of Deep Carious Dentin. *D. Cosmos,* 67:901, September 1925.

3. PRIME, J. M.: Further Extending Use of Howe's Ammoniacal Silver Nitrate in Control of Dental Caries. *D. Cosmos,* 77:1046, November 1935.

4. BARKER, J. N.: Sterilization of Dentine. *Austral. J. Dent.,* 39:156, May 1935.

5. HALEY, P. S.: Some New Chemical Methods for Treatment of Dentine in Pulpless Teeth, and in Vital Teeth Affected with Caries. *Brit. J. D. Sc.,* 74:47, 1929.

6. COOLIDGE, E. D.: Treatment of Deep Dental Caries. *Illinois D. J.,* 1:363, May 1932.

7. OSBORN, L. J.: Treatment of Dentine in Deep-Seated Cavities. *D. Rec.,* 44:259, May 1, 1924.

8. MILLER, W. D.: Comparative Rapidity with Which Different Antiseptics Penetrate Decalcified Dentin; or What Antiseptic Should Be Used for Sterilizing Cavities Before Filling? *D. Cosmos,* 33:337, May 1891.

9. SELTZER, S.: Comparative Value of Various Medicaments in Cavity Sterilization. J.A. D.A., 28:1844, November 1941.

10. *Idem:* Effective Duration of Some Agents Used for Dentin Sterilization. *J. D. Res.,* 21:115, April 1942.

11. *Idem:* Effectiveness of Antibacterial Agents Used in Cavity Sterilization. *J. D. Res.,* 21:269, June 1942.

12. BOUILLOUX, G.: Microchemical Detection and Determination of Silver and Mercury. *Bull. Soc. chim. biol.,* 7:184, 1940.

IN VITRO STUDIES ON STERILIZATION OF CARIOUS DENTIN. II. EXTENT OF INFECTION IN CARIOUS LESIONS

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THE rational use of germicides in the operative treatment of carious teeth depends largely on a knowledge of the extent of bacterial invasion in carious lesions. If infected dentin remains after cavity preparation, the application of a germicide is rational. On the other hand, if all infected dentin has been removed, the application of a germicide is not indicated unless to eradicate bacterial contamination resulting from the operative procedure. In planning dental operations, therefore, it is important to know the depth of penetration of bacteria into the carious lesions in order to determine either how much carious dentin must be removed to reach uninfected dentin, or how great a thickness of infected dentin must be penetrated by a germicide in order to render the dentin sterile.

The literature on the extent of infection of dentin in carious lesions is controversial. For example, Black[1] states that "careful observation has shown that microörganisms do not begin to grow into dentinal tubules until calcium salts have been dissolved out for some distance in advance of them"; whereas Kronfeld[2] states that "in studying the distribution of microörganisms in carious dentin, one is impressed with the fact that there are always a few tubules that contain organisms at a level far ahead of actual decalcification and decay." Perhaps this difference of opinion may be due to the possibility that, in the histologic section, one cannot tell exactly where the natural decalcification of caries ends and the artificial decalcification produced in histologic preparation begins. Zander[3] found isolated bacterial forms in the hard dentin in seven out of eighteen carious teeth. All softened carious dentin had been removed from the teeth prior to their extraction, and the presence of the bacterial forms was demonstrated by a staining technic after the usual histologic preparation. Zander's explanation of his findings is similar to that advanced by Hanazawa,[4] who believed that in acute caries decalcification precedes bacterial invasion, whereas, in chronic caries, the reverse is true. However, Canby and Bernier,[5] in a bacteriologic study of forty-six carious teeth, found that bacterial invasion was greater in acute caries than in chronic (arrested) caries. Analysis of Zander's tables reveals that no bacterial forms were seen in the sound dentin of the three Class I cavities and the four Class II cavities that were studied. In contrast, five of the six Class V cavities, and two of four Class III cavities showed bacterial forms. There may be some other explanation for Zander's histologic findings.

The experiments here reported were undertaken to determine the depth of penetration of infection in carious lesions, as determined by bacteriologic methods, and were a preliminary to a study of ways to sterilize dentin in carious teeth.

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It was believed that bacteriologic methods were necessary to establish the presence of viable organisms.

MATERIALS

Culture Medium.—The culture medium used in the previous study was employed in this also, and for the same reasons. (See page 1895.)

Instruments. — Cutting instruments (chisels and knives) were used to remove samples of carious dentin. These instruments were sterilized by heating to redness over a flame and were cooled before use. A freshly sterilized instrument was used for each cutting stroke.

The drills used to cut through sound dentin were constructed of stellite so that they could be repeatedly sterilized by flaming without losing their cutting qualities.

Teeth.—The carious teeth to be used in these experiments had been wrapped in moist gauze immediately after extraction and were used within four hours. The loose débris in the cavities was removed by washing with a jet of running water, but care was taken not to disrupt the carious dentin.

METHODS

In taking samples from the different levels in carious lesions, two approaches were employed: (1) from the carious dentin into the sound and (2) from the sound dentin into the carious.

With the first method, overhanging enamel was removed with chisels so as to expose the entire area of carious dentin. Starting on the carious surface, a series of samples of carious dentin were removed by cutting successive levels with sterile knives. Each knife was used for only one cutting stroke, and was then resterilized. Care was taken to reduce to a minimum the carrying of bacteria from the superficial dentin into the deep layers. The culture medium was inoculated

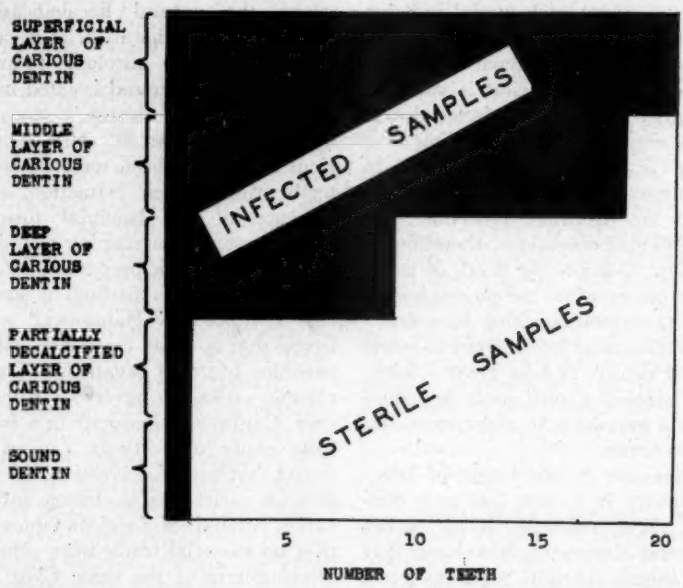

Fig. 1.—Extent of infection in carious dentin; samples of dentin taken at various levels from carious surface to sound dentin.

with samples taken from the superficial layer, the middle layer, the deep layer, the partially decalcified layer adjacent to sound dentin and the sound dentin.

With the second method, the carious material was approached from a sound surface that had been cleaned, washed with a detergent solution (zephiran 1:1,000) and freed of enamel by grinding with a sterile carborundum stone so as to expose a sterile surface of sound dentin. A hole was made into the exposed sound dentin with a sterile hand-operated stellite drill and a control culture taken. The hole was then extended into the carious dentin and samples for culture were taken at successive levels of the carious material. Each sample was taken separately with a sterile instrument and a tube of culture medium was inoculated with it. The tubes were examined on the second, fourth and seventh days of incubation and the presence of bacteria was determined by visible growth and stained smears. Subcultures were made in all doubtful cases.

RESULTS

The results obtained from twenty teeth by the first method are illustrated in Figure 1 and the results from sixty-nine teeth with the second method are shown in Figure 2. The dark areas represent the infected region, the light areas the sterile region. These areas are approximate since the depth of the various layers varies from tooth to tooth.

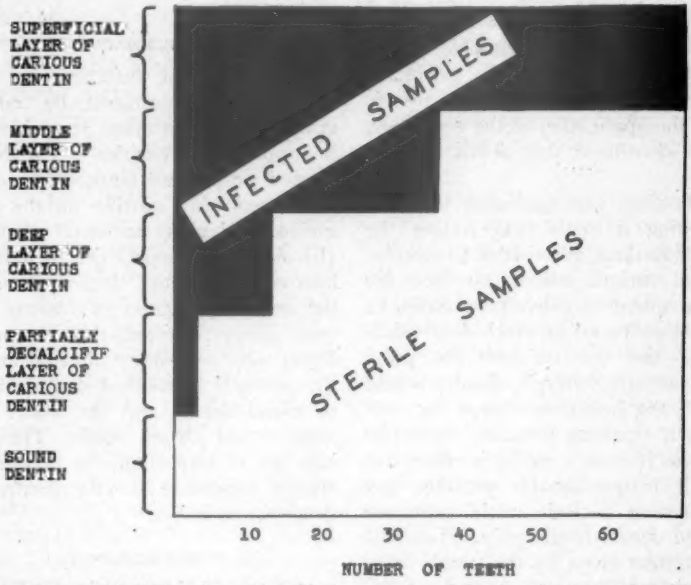

Fig. 2.—Extent of infection in carious dentin; samples of dentin taken at various levels from sound dentin to carious surface.

It is clear that the decalcification has preceded the bacterial invasion, and there is usually a layer of sterile decalcified dentin overlying the sound dentin.

No significant difference in depth of penetration of bacteria was observed for the various classes of carious lesions.

DISCUSSION

The results obtained by the first

method show a somewhat greater bacterial invasion than was obtained by the second method. Such results are to be expected, since the chance of carrying organisms from an infected layer to an adjacent sterile layer exists in the first method. This could explain the one case in which bacteria were found in the sound dentin. The assumption, therefore, that all carious dentin is infected is not valid.

These results are important in determining the ability of germicides to sterilize carious dentin, since sterility at a given depth in a carious lesion following the application of a germicide is not sufficient to prove that the germicide was effective. It must also be shown, prior to the application of the germicide, that the dentin at this depth was infected.

The findings are significant not only for devising a method of testing the ability of various germicides to sterilize dentin in carious lesions, but also for planning dental operative procedures. In those carious lesions in which decalcification has not yet reached the pulp, removal of all softened dentin would eliminate the infection, except for contamination resulting from the operative procedure. If such a cavity is effectively sealed, it is questionable whether any contaminating bacteria could penetrate the sound dentin to the pulp. The satisfactory results given by the usual methods of cavity filling support such a conclusion.

If, on the other hand, decalcification of dentin in a carious lesion has just reached the pulp, the invading bacteria may still be some distance away. In this case, it would seem logical to leave the sterile decalcified dentin in place rather than remove it and run the risk of injuring and infecting the pulp. Before filling such cavities, it would seem to be advisable to apply a germicide in order to destroy any surface bacterial contamination.

The risk of infecting the pulp during operative procedures could be eliminated by the development of a method to sterilize the carious lesion and the employment of a sterile technic. The use of a sterile technic has been advocated for root-canal therapy, and a practical procedure to accomplish this has been devised.[6] When it is possible to eliminate the infection in the carious dentin first, such a procedure is equally indicated for those deep carious lesions in which the pulp may become exposed during cavity preparation.

SUMMARY

The extent of infection in carious lesions was determined by culturing samples of dentin taken at various levels in unprepared cavities of freshly extracted teeth. Two methods of sampling were used: (a) starting on the carious surface and going to sound dentin and (b) starting in sound dentin and going into carious dentin. It was found that the superficial layers of carious dentin were always infected, that intermediate layers were sometimes infected and that the partially decalcified dentin adjacent to sound dentin and the sound dentin were almost always sterile. These findings are of importance in planning operative procedure for the treatment of deep carious lesions.

BIBLIOGRAPHY

1. BLACK, G. V.: Operative Dentistry. Vol. I. Ed. 6. Chicago: Medico-Dental Publishing Co., 1924, pp. 70-71.

2. KRONFELD, RUDOLF: Histopathology of Teeth. Ed. 2. Philadelphia: Lea & Febiger, 1939, p. 132.

3. ZANDER, H. A.: Use of Silver Nitrate in Treatment of Caries. J.A.D.A., 28:1260, August 1941.

4. HANAZAWA, K.: *Vierteljhrsschr. f. Zahnheilk.*, 1923, p. 417.

5. CANBY, C. P., and BERNIER, J. L.: Bacteriologic Studies of Carious Dentin. J.A.D.A., 23:2083, November 1936.

6. BLAYNEY, J. R.: Problem of Teaching Root Canal Technics. J.A.D.A., 11:1187, December 1924.

IN VITRO STUDIES ON STERILIZATION OF CARIOUS DENTIN. III. EFFECTIVE PENETRATION OF GERMICIDES INTO CARIOUS LESIONS

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IN a previous study of this series, it was shown that of a great number of germicides, a saturated solution of silver nitrate is by far the most effective for sterilizing carious dentin, and that even this substance must reach an appreciable concentration in dentin to destroy all the bacteria.[1] In a second study, it was shown that there is nearly always a layer of sterile, partially decalcified dentin between the sound dentin and the infected part of the cavity.[2] It was suggested that, in treating deep carious lesions, it might be safer to leave the deepest layer of carious dentin rather than expose the pulp, provided the sterility of this dentin could be insured. It therefore seemed desirable to determine just how great a thickness of infected dentin can be sterilized by an application of silver nitrate to a tooth for a time that is feasible in routine dental practice. It also seemed desirable to establish whether some of the other commonly used germicides could be effective for this purpose.

METHOD

In order to demonstrate that a germicide has sterilized the dentin in a carious lesion to a given depth, it is first necessary to establish that such dentin is infected at this depth.[2] This must be done without making an opening through to the carious surface, as otherwise any germicide applied to the carious surface would gain direct access to the deeper layers. The instrument shown in the accompanying figure was constructed for this purpose. (See page 1907.)

The principal parts of this instrument are (A) a clamp, mounted on an adjustable ball-and-socket joint, which holds the tooth firmly by the root with the crown fully exposed, and (B) and (C) two dental handpieces that are universally adjustable for both position and direction and are mounted in a micrometer screw arrangement, permitting advancement or retraction for distances measurable to 0.1 mm. Sterile dental drills used for taking samples of tooth substance at measured distances from the carious surface are held and rotated in these handpieces. The rotating shaft of the handpieces can be withdrawn readily in order to facilitate repeated removal of the bur from the tooth, as in taking samples for culture.

The experiments were performed with sterile technic and were carried out as follows: The depth of infection in the carious tooth substance was established by taking samples at measured distances from the carious surface with the handpiece (B). This was done by cutting from a sterilized sound surface into the carious lesion. The germicide was then

From the Chemistry Laboratory of the Walter G. Zoller Memorial Dental Clinic, University of Chicago.

applied to the carious surface and was washed off after a measured time interval. A series of samples were then taken with the other handpiece (C), starting at the carious surface and going down to the desired depth.

Tubes of culture medium (see page 1895) were inoculated with samples taken in this manner and incubated at 37° C. The tubes were observed for bacterial growth on the second, fourth and seventh days. Gram-stained smears and subcultures were made from tubes that were negative or doubtful. Only experiments in which it had been established that the deepest layers giving negative cultures after application of the germicide had given positive cultures before application of the germicide were considered valid. These experiments that yielded negative cultures at the test depth in the carious dentin were discarded as non-valid.

TABLE 1.—STERILIZATION OF CARIOUS DENTIN WITH SATURATED SILVER NITRATE APPLIED FOR THREE MINUTES

Description of Sample	Days 2	4	7	Gram-Stained Smear
Before treatment				
Sound dentin (control)	—	—	—	—
Carious dentin 1.5 mm from surface	+	+	+	+
After treatment				
Superficial carious dentin	—	—	—	—
Carious dentin 0.5 mm.	—	—	—	—
Carious dentin 1.0 mm.	—	+	+	+
Carious dentin 1.5 mm.	+	+	+	+

RESULTS

The results of a typical experiment are given in Table 1. In this experiment, it will be noted that the sample taken at the 1.5 mm. level before application of silver nitrate was infected. We can assume that everything superficial to that level was also infected, since previous experiments showed this to be true.[2] After treatment with the germicide, it can be seen that organisms did not grow from the 0.5 mm. level, but did grow from the 1.0 mm. level. We can conclude that sterilization has been achieved to a depth of at least 0.5 mm., but not to 1.0 mm.

Table 2 contains a summary of experiments comparing the ability of saturated silver nitrate, Howe's ammoniacal silver nitrate solution, 20 per cent zephiran (alkyl dimethyl benzyl ammonium chloride), 30 per cent hydrogen peroxide and 95 per cent phenol to sterilize carious dentin. It will be noted that saturated silver nitrate is effective in sterilizing carious dentin, and that the length of time during which it is applied largely

TABLE 2.—EFFECTIVE PENETRATION OF GERMICIDES INTO CARIOUS LESIONS

Germicidal Solution	Time Applied Minutes	Average Depth of Sterilization* Mm.	Mean Deviation†
Silver nitrate (saturated aqueous solution)	1	0.3	0.1
	3	0.7	0.3
	10	1.3	0.3
Ammoniacal silver nitrate (Howe's solution)	3	0.6	0.4
Hydrogen peroxide (30 per cent) (superoxol)	3	0.4	0.4
	10	0.8	0.7
Alkyldimethylbenzyl ammonium chloride 20 per cent (zephiran 1:5)	3	0.0	0.0
Phenol 95 per cent (liquid phenol)	3	0.0	0.0

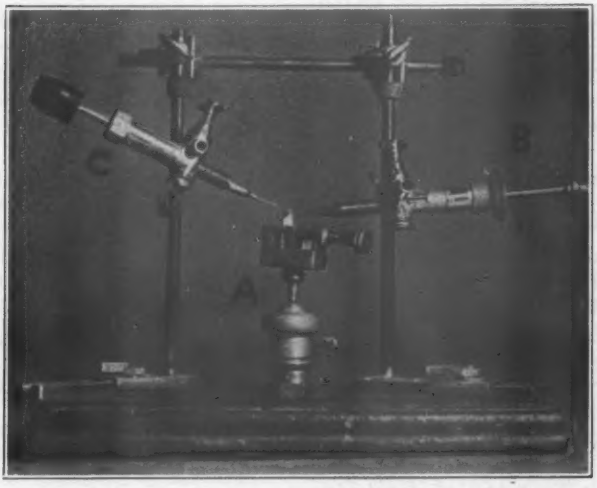
*Each figure is the average of results from at least ten experiments.

†When the figure for the mean deviation is subtracted from the figure for the average depth of sterilization, the result closely approximates the minimum depth of sterilization.

determines the extent of sterilization. Howe's solution of ammoniacal silver nitrate was effective, but somewhat less so than saturated silver nitrate. Hydrogen peroxide 30 per cent was still less effective. Its penetration was quite variable, and it cannot be considered as reliable as silver nitrate for sterilizing infected dentin. Liquid phenol 95 per cent and zephiran 20 per cent were ineffective. In most experiments, they failed to sterilize even the superficial layer.

ADDITIONAL EXPERIMENTS

In order to test the ability of saturated silver nitrate to sterilize carious dentin left in a cavity floor over the pulp, the following type of experiment was performed on freshly extracted teeth. Third molars with extensive decay were selected. A cavity was prepared for filling by breaking down all undermined enamel and removing the superficial carious dentin, care being taken to leave a floor of leathery dentin from 1 to 2 mm. thick. A pledget of cotton soaked with a saturated solution of silver nitrate was applied to the cavity for three minutes. The cavity was then dried with sterile cotton pledgets and a chip blower, and filled with zinc oxide-eugenol paste. After placement of the filling, the teeth were put into a humid chamber to prevent drying and incubated at 37° C. for twenty-four hours. At the end of this period, the filling was removed, with sterile technic. The carious floor was cut out, ground in broth and cultured. In addition, samples of the harder dentin beneath the carious floor were taken out and cultured. All samples were incubated for four days, and bacterial growth was checked with gram-stained smears and by subculture.



Instrument for taking samples of dentin at measured distances from carious surface.

Seventeen teeth so treated showed no pulp exposures when the carious floor was removed, and all of these gave negative cultures from the floor of carious dentin and the hard dentin beneath this layer. Twelve other teeth showed pulp exposure when the leathery dentin was removed, and, of these, nine gave negative cultures and three showed bacterial

growth. Of the three in which sterility was not produced, it could not be established whether the infection came from the dentin or from the exposed pulp. However, in view of the uniformly sterile dentin in the seventeen cases in which the pulp was not exposed, it seems reasonable to assume that the infection was from the pulp.

DISCUSSION

These results make it evident that sterilization of infected dentin in carious lesions is possible with a saturated solution of silver nitrate, but only if an adequate procedure is followed. The time of application is all important. It seems unreasonable in clinical practice to rely on guesswork to measure the time for application. A clock or other timing device should be used.

The finding that phenol is of practically no value for application as a germicide if any appreciable thickness of infected dentin must be sterilized is particularly significant in view of the traditional use of this agent for cavity sterilization. Equally ineffective is a new germicide of great apparent potency, zephiran (phenol coefficient about 300).

The results obtained with 30 per cent hydrogen peroxide (superoxol) show much greater variation than those obtained with the other germicides. When the hydrogen peroxide was applied to carious dentin, a mass of bubbles quickly formed which apparently interfered with further penetration. Since the enzyme catalase (which decomposes hydrogen peroxide to water and oxygen) is present in carious dentin, the inactivating influence of this substance must be considered. The somewhat greater effectiveness of superoxol found in the previous study[1] can be explained by the fact that, in the method employing pieces of carious dentin, the hydrogen peroxide could penetrate from six surfaces instead of only the one, as in this study, and the blocking influence of the bubbles of oxygen on the further penetration of the hydrogen peroxide solution would be correspondingly less. These findings confirm the observations made by W. D. Miller,[3] who also obtained inconstant results with hydrogen peroxide.

These studies have not determined whether injury to the dental pulp may result from the application of a germicide. Silver nitrate has been extensively used in the treatment of carious lesions, apparently without any serious pulp reactions. Nevertheless, the possibility of injury to the pulp by application of germicides to carious dentin should not be disregarded.

SUMMARY

A special apparatus was constructed which permitted determination of the depth of sterilization produced by germicides in carious lesions of extracted teeth. It was found that a saturated solution of silver nitrate sterilized carious dentin to an average of 0.3 mm. by a one-minute application, 0.7 mm. by a three-minute application and 1.3 mm. by a ten-minute application. Ammoniacal silver nitrate (Howe's solution) was slightly less effective. A 30 per cent solution of hydrogen peroxide (superoxol) was much less effective and very unreliable. A 20 per cent solution of zephiran and 95 per cent phenol were ineffective.

BIBLIOGRAPHY

1. MUNTZ, J. A.; DORFMAN, ALFRED, and STEPHAN, R. M.: In Vitro Studies on Sterilization of Carious Dentin: I. Evaluation of Germicides. J.A.D.A., 29:1893, December 1943.

2. DORFMAN, ALFRED; STEPHAN, R. M., and MUNTZ, J. A.: In Vitro Studies on Sterilization of Carious Dentin: II. Extent of Infection in Carious Lesions. J.A.D.A., 29:1901, December 1943.

3. MILLER, W. D.: Comparative Rapidity with Which Different Antiseptics Penetrate Decalcified Dentin: Or What Antiseptic Should Be Used in Sterilizing Cavities Before Filling? *D. Cosmos*, 33:337, May 1891.

STUDIES ON GRAMICIDIN AND RELATED SUBSTANCES: BACTERICIDAL EFFECT OF TYROTHRICIN ON ORAL BACTERIA*

F. GEORGE JOHNSON,† D.M.D., Boston, Mass.

TYROTHRICIN is the name given by Dubos[1] to a recently discovered substance which can kill gram-positive organisms. He isolated it in a crude form from an aerobic spore-bearing soil bacillus, *Bacillus brevis*. Later,[2] he found that the tyrothricin could be subdivided into two crystalline fractions, tyrocidin and gramicidin, the latter exhibiting the greater bacterial action.

In the oral cavity, gram-positive organisms are present in a high percentage of the infectious processes. Also, the majority of the strains of micro-organisms found in the mouth, normally and during active infections, vary from those found elsewhere in the body. Therefore, it was of interest to study the effect of these new bactericidal agents upon the oral flora. In doing this, *in vitro* tests of the action of tyrothricin upon organisms isolated from the oral cavity have been made. The effect of this agent upon the motility of spirochetes and other motile flora has been determined by a method similar to that described by Rosenthal.[3] Some experiments upon the activity of tyrothricin after its addition to saliva have been performed. Tests for toxicity of this agent for the mucous membranes were carried out upon laboratory animals and also upon the human oral mucosa.

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†This paper is abstracted from a thesis submitted in March 1942, in fulfilment of the requirements of the third year tutorial seminar of Harvard Dental School.

PROCEDURE

The micro-organisms tested were isolated from the saliva, from root canals and from periapical abscesses of patients from the operative clinics. Owing to the difficulty of isolating crystalline gramicidin in quantities, it was necessary to use a crude extract of tyrothricin for the experiments described below. Because of the relatively feeble action of the tyrocidin present, it seems fair to attribute the observed bactericidal effect of the crude mixture to its gramicidin content. The tyrothricin used was prepared and assayed in the Department of Bacteriology of the Harvard Medical School. The solution used contained 5.95 mg. of tyrothricin per cubic centimeter.

Bactericidal Action.—In general, for determining the bactericidal action, a series of dilutions of tyrothricin in broth cultures were prepared, to which a known inoculum of test organisms was added. These cultures were incubated at 37.5 C. At various intervals, small portions were withdrawn for tests of the viability of the organisms present at that time. A detailed description of the procedure follows.

Dilution of Tyrothricin.—A 10 per cent solution of glucose in distilled water was autoclaved at 10 pounds for ten minutes. Nine cubic centimeters of the 10 per cent glucose solution was pipetted into each of four test tubes and these were labeled Nos. 1, 2, 3 and 4, respectively. To tube No. 1, there was added 1 cc. of the stock solution containing

TABLE 1.—EFFECT OF TYROTHRICIN ON ORAL BACTERIA IN VITRO

Test Organisms	Hours Incubation	Control	Concentrations of Tyrothricin (5.95 mg. per cc. x exponent given for each column)				
			10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}
Diplococcus pneumoniae	4	++++	—	—	+++	++++	++++
	24	++++	—	—	+	++++	++++
	48	++++	—	—	—	+++	++++
Streptococcus haemolyticus Group C	4	++++	++++	++++	++++	++++	++++
	24	++++	—	—	—	—	++
	48	++++	—	—	—	++++	++++
Streptococcus haemolyticus Group A	4	++++	—	—	+	++	+++
	24	++++	—	—	—	+++	+++
	48	++++	—	—	+	++++	—
Streptococcus gamma	4	++++	—	—	+	+++	++++
	24	++++	—	—	—	++++	++++
	48	++++	—	—	+	++++	++++
Streptococcus viridans	4	++++	—	—	—	+	++++
	24	++++	—	—	+	+	++
	48	++++	—	—	—	++	+++
Streptococcus salivarious Group C	4	++++	—	—	++	+++	++++
	24	++++	—	—	++++	++++	++++
	48	++++	—	—	++++	++++	++++
Staphylococcus albus	4	++++	—	—	++++	++++	++++
	24	++++	—	—	++	++++	++++
	48	++++	—	—	++++	++++	++++
Staphylococcus albus-haemolyticus	4	++++	—	++	+++	+++	++++
	24	++++	—	+++	++++	++++	++++
	48	++++	++++	++++	++++	++++	++++
Staphylococcus aureus-haemolyticus	4	++++	—	—	++++	++++	++++
	24	++++	—	—	++++	++++	++++
	48	++++	—	—	++++	++++	++++
Staphylococcus citreus	4	++++	—	—	++	++++	++++
	24	++++	—	—	++++	++++	++++
	48	++++	—	—	++	++++	++++
Staphylococcus albus and Streptococcus viridans (periapical abscess)	4	++++	—	—	—	++	++++
	24	++++	—	—	++	++++	++++
	48	—	—	—	—	—	+
Gaffkya tetragena	4	—	—	—	—	—	—
	24	++++	—	—	—	++++	++++
	48	++++	—	—	+++	++++	++++

TABLE 1.—EFFECT OF TYROTHRICIN ON ORAL BACTERIA IN VITRO—(Continued)

Test Organisms	Hours Incubation	Control	Concentrations of Tyrothricin (5.95 mg. per cc. x exponent given for each column)				
			10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}
Sarcina lutea	4	++++	—	++	+++	++++	++++
	24	++++	—	—	—	++++	++++
	48	++++	—	—	+++	++++	++++
Lactobacillus odontolyticus-acidophilus (pH 7.6 dextrose broth medium)	4	++++	—	++++	++++	++++	++++
	24	++++	—	—	++++	++++	++++
	48	++++	—	—	++++	++++	++++
Lactobacillus odontolyticus-acidophilus (pH 5.0 dextrose broth medium)	4	++++	—	+++	++++	++++	++++
	24	++++	—	—	+	++++	++++
	48	++++	—	—	—	—	—
Haemophilus influenzae	4	++++	++++	++++	++++	++++	++++
	24	++++	++++	++++	++++	++++	++++
	48	++++	++++	++++	++++	++++	++++
Neisseria catarrhalis	4	++++	++++	++++	++++	++++	++++
	24	++++	++++	++++	++++	++++	++++
	48	++++	++++	++++	++++	++++	++++

5.95 mg. of tyrothricin per cubic centimeter. After mixing, 1 cc. of the solution in tube No. 1 was transferred to tube No. 2. The procedure was repeated for preparation of tubes 3 and 4. From these dilutions of tyrothricin in glucose, numerous cultures were prepared.

Culture Preparations.—Nine cubic centimeters of that broth medium which is suitable for the growth of the particular organism being tested was pipetted into a series of five tubes. To tube No. 1a was added 1 cc. of the stock solution of tyrothricin, making the dilution 10^{-1} of Table 1. To tube No. 2a was added 1 cc. of the solution of tyrothricin in glucose contained in tube No. 1, thus making dilution 10^{-2} of the table. Dilutions 10^{-3}, 10^{-4} and 10^{-5} were made in a similar manner. To these final mixtures was added a 1 per cent inoculum of an 18-hour broth culture of the test organism. Control cultures containing no tyrothricin were prepared at the same time.

The cultures were then incubated at 37.5 C. At intervals of four hours, twenty-four hours and forty-eight hours, a loopful of the culture was streaked on the solid medium suitable for the growth of the particular organism being tested. These agar plates were incubated for twenty-four hours and then examined to determine whether growth was present.

In Table 1, ++++ indicates that the growth of the organism was equal to that in the control culture and that therefore the tyrothricin present had no bactericidal effect. Fewer plus signs indicate inhibition of growth and a minus sign indicates that growth was entirely prevented.

In Table 1, it can be noted that tyrothricin in the highest concentration em-

ployed was not effective against organisms of the gram-negative group. In concentrations of 0.0595 mg. per cubic centimeter, it was effective in preventing the growth of most of the gram-positive group which was tested. With a number of organisms of this group, it was still effective at even lower concentrations, especially with the streptococci. Details are shown in Table 1.

In contrast to the general trend are the data on *Streptococcus haemolyticus* Group C, *Staphylococcus albus-haemolyticus* and *Lactobacillus odontolyticus-acidophilus.* In the case of *Streptococcus haemolyticus* Group C, an incubation period of more than four hours was necessary for tyrothricin to be effective. With *Staphylococcus albus-haemolyticus* and *Lactobacillus odontolyticus-acidophilus,* tyrothricin exerted a bactericidal action only when its concentration was at least 0.595 mg. per cubic centimeter. Apparently, the latter organisms are more resistant to this agent.

In the case of *Staphylococcus albus-haemolyticus,* growth was not inhibited in those portions tested after forty-eight hours' incubation with tyrothricin; whereas it had been by those in which tyrothricin had acted for a shorter period. Since there was no evidence of contamination of this run, some additional explanation of the anomalous behavior must be sought.

EFFECT OF TYROTHRICIN ON THE MOTILE ORAL FLORA

Since the motile flora, such as the spirochetes and fusiform bacilli, are frequently associated with oral disease, considerable attention was given to testing the action of tyrothricin upon microorganisms of this group. The inoculum was taken from the cervical margins of the teeth with a sterile capillary pipet and immediately tested. The inoculum contained large numbers of *Treponema microdentium* or *macrodentium, Treponema vincenti,* vibrios, fusiform bacilli, motile bacilli and a few *Treponema buccalis* and *Treponema mucosum* organisms. A method similar to that suggested by Rosenthal[3] was employed. The motility of the organisms was used as the criterion in determining the bactericidal activity of the agent. It is realized that motility is not an accurate index of metabolism of the organism. However, as a control, simultaneous tests of other bactericidal substances were also made. Therefore, the results in Table 2 give some idea of the relative bactericidal action of tyrothricin. The motility of the

TABLE 2.—EFFECTS OF TYROTHRICIN AND SOME BACTERICIDES UPON THE MOTILE ORAL FLORA

Product Tested	Motility*		
	Vibrios	Bacilli	Spirochetes
Tyrothricin (dilutions) 10^{-2}	+	+	+
10^{-3}	— —	—	+
10^{-4}	— —	— —	—
10^{-5}	— —	— —	— —
Modified phenol†	+	+	+
Ethyl alcohol (95 per cent)	+	+	+
Ethyl alcohol (9.5 per cent)	— —	— —	— —
Beechwood creosote 0.5 per cent	—	—	+
Hexylresorcinol 1:1,000	—	—	— —
Sulfathiazole in water 5 per cent	— —	— —	— —
Glucose 10 per cent	— —	— —	— —

*+, ceased; —, lessened; — —, unaffected in ten-minute period.
†2 parts menthol, 4 parts thymol, 9 parts phenol, 0.25 parts water.

organisms was observed under the dark-field microscope with Rosenthal's[3] slide technic. The results are recorded as plus when motility was reduced or ceased, and as minus when motility was unaffected. The time limit for each test was ten minutes. Each test was repeated until three similar results were obtained. Inspection of Table 2 shows that tyrothricin had greater effect upon the motility of spirochetes than it did upon that of bacilli or vibrios. In this, its effect is similar to that of the more efficient bactericides, such as phenol and alcohol. Since the crude tyrothricin extract contains alcohol, control experiments were made in which alcohol only in various concentrations was present. The motility was halted by 95, but not by 9.5, per cent alcohol.

BACTERICIDAL ACTION OF TYROTHRICIN IN SALIVA

Dubos[4] found that gramicidin was less effective against organisms when phosphate buffers were present. Since saliva has buffering ability, it was of interest to test the action of tyrothricin in the presence of this natural body fluid.

Experiments were carried out on two specimens, from different individuals and collected with the aid of paraffin chewed for a period of twenty minutes. The bactericidal tests were performed in the manner outlined above. Saliva was substituted for the broth medium in the culture preparation. No inoculum other than the saliva was added. The colonies on the solid medium were smeared and gram-stained to determine whether gram-positive organisms were present, it being assumed that gram-negative ones would be present.

In some of these experiments, tyrothricin was added to specimens of saliva in amounts sufficient to produce a concentration of 0.595 mg. per cubic centimeter. These mixtures were incubated for four hours and then tests for viable organisms were made. At this concentration, tyrothricin acted upon the gram-positive flora so that growth did not occur in the viability tests. Lower concentrations of tyrothricin added to saliva were ineffective, even when incubated for longer periods. In general, experiments in this series showed that, when saliva is present, the concentration of tyrothricin required was higher than that for pure cultures of mouth organisms. The inhibition of the bactericidal activity of the substance by saliva may be explained (1) by the presence of certain inhibitory substances or (2) by the presence of strains that are resistant to tyrothricin, as has been found by Rammelkamp.[5]

TOXICITY OF TYROTHRICIN FOR THE MUCOUS MEMBRANES

Tests of the effect of tyrothricin on the oral mucosa were made. In these, it was hoped to learn something regarding its safety as a possible therapeutic agent. A 10^{-2} dilution of tyrothricin in 10 per cent glucose was used by me as a mouth rinse and gargle, being retained in the mouth for five minutes. No tissue changes were observed. Also, the concentrated stock solution was swabbed and rubbed hard into a selected area on the buccal mucosa repeatedly every twelve hours for ten days, with no toxic reaction.

Some of the undiluted tyrothricin stock solution (0.5 cc.) was injected within the mucous membranes of the buccal folds of a guinea-pig until a swollen papule was formed. In twelve hours, this swollen area had disappeared and no toxic effects could be observed. Four guinea-pigs each received 0.3 cc. of the 1:20 dilution of the stock tyrothricin injected into the gingivae between the lower incisor teeth. No toxicity was observed except a slight cyanosis, which no doubt was due to trauma.

MOUSE PROTECTION TESTS

In 1891, W. D. Miller[6] described experiments in which he injected saliva of

apparently healthy individuals intraperitoneally into mice. A total of 111 animals were used. Each received 1 or 2 drops of mixed saliva. In ten days, eighty-four were dead. During the present investigation, I injected mice with 0.5 cc. of whole mixed saliva. Seventy-five per cent of the animals died within a period of from three to ten days with peritonitis. A similar group of mice were given 0.5 cc. of saliva plus 0.25 cc. of a 10^{-2} dilution of tyrothricin in glucose introduced ten minutes after the saliva. A third group of animals, as a control, received a similar dose of tyrothricin only. Injection of tyrothricin alone had no toxic effects. The animals which received tyrothricin shortly after the saliva injection all were protected against infection. This is in decided contrast with the effect of injection of saliva only.

In a second series of mouse experiments, with a dosage of 1 cc. of saliva and 0.3 cc. of tyrothricin, 10^{-2} dilution, all animals died.

SUMMARY

A study of the bactericidal power of tyrothricin on oral bacteria has been carried out *in vitro*. Organisms used were isolated from specimens of saliva, from root canals and from periapical abscesses. The tyrothricin, in the presence of 10 per cent glucose, was found to be effective against gram-positive organisms when its concentration was 0.06 mg. per cubic centimeter or greater. Its bactericidal action was usually at a maximum at the end of four hours. It had a tendency to be more effective against streptococci than against the other organisms tested. Whole saliva partially inhibited the bactericidal power of tyrothricin.

At the concentration just mentioned, the action of tyrothricin inhibited the motility of spirochetes. A tenfold concentration was necessary for bacilli and vibrios.

When tyrothricin was applied locally on mucous membranes, it was found to be non-toxic for guinea-pigs and in the one human case tested.

Tyrothricin given intraperitoneally in the quantity of 0.015 mg. protected mice against 0.5 cc. of whole saliva given in the same manner. This dose was ineffective against 1 cc. of mixed saliva.

BIBLIOGRAPHY

1. DUBOS, R. J.: *J. Exper. Med.*, 70:1, July 1939.

2. *Idem: J. Biol. Chem.*, 141:155, October 1941.

3. ROSENTHAL, S. L.: *J. Periodontol.*, 8:71, July 1937.

4. DUBOS, R. J.: Public lecture, Harvard Medical School, March 1942.

5. RAMMELKAMP, C. H.: *Proc. Exper. Biol. & Med.*, 49:346, March 1942.

6. MILLER, W. D.: *D. Cosmos*, 33:791, October 1891.

IRRIGATION OF ROOT CANALS

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ONE of the most neglected phases of root therapy is the removal of débris from the canal. It is an axiomatic principle of surgery that before a wound is ready for chemotherapy, all necrotic material and débris must be removed. Many dentists have failed to understand the importance of this basic rule of surgery and have relied principally upon drug therapy. It is rather an interesting, albeit deplorable, commentary that the question most commonly asked of an endodontist is: "Doctor, what drug are you now using in root canals?" The need for mechanical instrumentation and the importance of removing resultant débris, as well as pulp remnants, is often lost sight of.

The necessity for thorough wound cleansing was recognized during the last war. Carrel[1] said:

> Most important in the preparation of the wound is the mechanical cleansing of the infected regions. It is well known that . . . necrosed tissues serve as shelters for microbes and protect them from the antiseptic.

The necessity for wound cleansing is again recognized in this war. Less than two months after the Pearl Harbor attack, Cloward[2] discussed head injuries incurred at that time, emphasizing that "a thorough débridement and cleansing . . . is perhaps the most important part of the operative procedure." Thorough débridement and cleansing is as necessary in root therapy as it is in surgery. In many recalcitrant cases encountered in the clinic of this school, as well as in private practice, negative cultures followed fresh irrigation of the canal as described below.

Root-canal therapy may be divided arbitrarily into three phases: (1) mechanical preparation; (2) chemical preparation; (3) disinfection. Mechanical preparation of the canal by means of instruments will not be discussed here, except to say that its importance must be stressed. The recesses in necrotic dentin provide the temples in which bacteria live, and the tags of pulp tissue provide the feasts on which they thrive. Mechanical instrumentation should be followed by irrigation of the canal in order to wash out fragments of pulp tissue and dentinal shavings. Débris and organic tissue, which are present more often than one anticipates, are automatically removed by the irrigating solution. Irrigation may also be used to wash out food débris after the canal has been left open for drainage during the acute stage of periapical abscess, etc.

Irrigation of root canals may be carried out in every operable tooth in which the canal has been widened sufficiently to receive a No. 3 or No. 4 Kerr root-canal instrument. In other cases, irrigation of the mouth of the canal only will be possible. The technic of irrigation is simple, the only armamentarium required being a small syringe, to be used only for that purpose. A small syringe is preferable because only small quantities of solution (0.5 cc.) are used at a time and because the small syringe is more readily identified as an irrigating syringe to be used for a specific purpose. An all-glass 1.5 cc. syringe is fitted with a 1¼ inch stainless steel needle of 25 gage. The needle, with stylet in place, should be

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bent to an obtuse angle so as to reach the canals of posterior, as well as anterior, teeth more readily. The bevel of the needle should be removed with a carborundum disk so as to make the end blunt.

The solutions used for irrigating are chlorinated soda solution U.S.P. (made up in double strength) and hydrogen peroxide U.S.P. The chlorinated soda solution (liquor sodae chlorinatae, U. S.P., also called Labarraque's solution) is made up in double strength according to the following formula:

Fig. 1.—Syringe and blunt needle used for irrigation of root canals.

Monohydrated sodium carbonate	276 grains (18 gm.)
Chlorinated lime	398 grains (26 gm.)
Water	q.s. ad 4 ounces

Dissolve sodium carbonate in 2 ounces of water, triturate the chlorinated lime with 2 ounces of water; mix; shake occasionally and let stand overnight; shake again and filter. Keep in cool place. Do not use if more than 3 months old.

Chlorinated soda is used for irrigating, in preference to some other solution, because it has been shown[3] that it is the most effective solvent of pulp tissue, and because, in combining with hydrogen peroxide, it effervesces and liberates nascent oxygen.

The technic of irrigation is simple, but the details must be carried out carefully. The sterile syringe with needle attached is filled with the chlorinated soda solution. The needle is inserted part way into the root canal. It should never be inserted so that it binds. Sufficient room between needle and canal wall should be allowed for the return flow of the solution. In many cases of upper anterior teeth, the needle can be inserted for a distance of two-thirds the length of the canal without binding. In

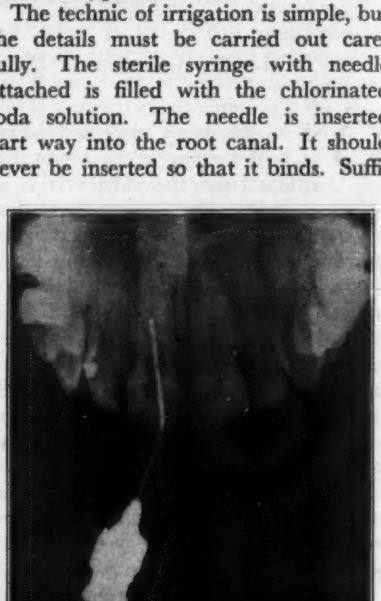

Fig. 2.—Extent to which irrigating needle can be carried into root canal of anterior tooth without binding.

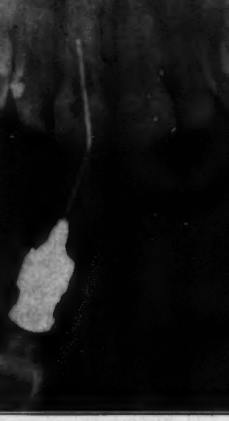

Fig. 3.—Débris removed from canal by irrigation. The cotton rolls were used successively from 1 to 3, to absorb the irrigating solution as it dripped from the root canal.

most cases, there is no need to advance the needle that distance into the canal.

After making certain that the needle does not bind, the operator ejects the solution from the syringe with little or no pressure on the plunger. The object is to wash out the canal, not to force the solution under pressure. The return flow of solution is caught on a cotton roll. In irrigating lower teeth, particularly posterior teeth, the convenience of gravity is not available and it may be necessary to mop up the solution with a cotton roll held in pliers as the solution collects on the rubber dam. Final mopping up in the pulp chamber is done with sterile pledgets of cotton. Irrigation of the canal should be repeated with 0.5 cc. of the chlorinated soda solution until 2 cc. of the solution has been used or until particles of débris are no longer washed out on the cotton roll. If irrigation is carried out during the first treatment, the chlorinated soda solution may be sealed in the canal to disinfect it and to dissolve remnants of pulp tissue.

To make more effective the removal of débris from the root canal, irrigation may be carried out alternately with chlorinated soda solution and hydrogen peroxide. About 0.5 cc. of one solution is followed by a similar amount of the other, alternate irrigation being continued until the canal has been completely cleansed of débris. The alternate use of these solutions will cause prompt effervescence and help to force the débris toward the widest part of the canal; i.e., toward the pulp chamber. There is no danger of forcing the débris apically if the syringe needle fits the canal loosely, since the force of the effervescence will follow the line of least resistance; namely, toward the mouth of the canal and into the pulp chamber. As a byproduct of this reaction, nascent oxygen is liberated according to the following equation:

$$NaOCl + H_2O_2 \rightarrow NaCl + H_2O + O_2$$

Sod. hypochlorite + hydrogen peroxide → Sodium chloride + water + oxygen

Alternate irrigation, using about 0.5 cc. of each solution, may be repeated three or four times, until no signs of débris are seen on the cotton roll. The final irrigating medium must always be the chlorinated soda solution, since any hydrogen peroxide left in the canal may combine with blood or organic material and form a gas, thus causing pressure. Such pressure, when confined within a sealed root canal, will cause swelling and pain of the periapical tissues. It is important, therefore, that the final irrigating solution used be chlorinated soda.

In many cases, slight bleaching of the pulp chamber will follow irrigation, whether this is done with the chlorinated soda solution used alone or combined alternately with hydrogen peroxide. While this is a secondary effect, it is desirable, since it not only cleans, but also helps to prevent future discoloration of the tooth.

Irrigation should be followed by thorough drying of the canal with absorbent points. A medicament is then sealed in the canal in the usual manner. If the canal has been properly cleansed by mechanical means and adequately irrigated, better disinfectant action of the medicament is assured.

BIBLIOGRAPHY

1. CARREL, ALEXIS, and DEHELLY, G.: Infected Wounds. New York: P. B. Hoeber, 1919, p. 80.

2. CLOWARD, R. B.: *J.A.M.A.*, 118:267, January 24, 1942.

3. GROSSMAN, L. I., and MEIMAN, B. W.: Solution of Pulp Tissue by Chemical Agents. J.A.D.A., 28:223, February 1941.

Fortieth and Spruce Streets.

PROPHYLACTIC VALUE OF THE SULFONAMIDES IN TRAUMATIC DENTAL SURGERY

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AT any Army dental installation, where hundreds of surgical procedures are carried out, the dental officer is often faced with the disturbing postoperative picture of pain, edema, hemorrhage, trismus and infection, particularly in a certain percentage of the more complicated cases. Some of these conditions can be remedied by the surgeon. Stated in general terms, trauma of the various branches of the fifth and seventh cranial nerves, of the muscles of mastication or of the temporomandibular joint frequently leads to excessive pain, trismus and edema. Injury to the external or internal maxillary artery or its branches causes hemorrhage. In keeping with the military efficiency of the present Army and of the high standards set by its medical department, it seemed worth while, in the course of routine work involving the daily examination and treatment of a great many patients, to evaluate the rôle of the complicating factors in the healing process. An analysis of the data obtained over a period of months gave weight to some seemingly pertinent findings.

1. The stress of military duty interferes with or precludes routine postoperative care.

2. A shortage of trained assistants makes the incidence of infection more of a problem. This situation should lead the dental officer to be constantly alert to the fact that such organisms as *Streptococcus hemolyticus* and *Staphylococcus aureus* may be brought to a wound by human carriers.

3. Certain structures and spaces in the oral cavity, when penetrated by injection or operative procedure, prove to be vulnerable to invasion by pathogenic organisms. The characteristic structure of these areas makes them traps or potential reservoirs for infection, which, once it has thus gained a foothold, may spread by means of fascial planes, glands, ducts and lymph channels.

4. The veins of the face, lips and nose are often avenues for the rapid spread of infection to the cavernous sinus.

5. Changes in facial expression, talking, eating, etc., create a situation favorable to the dispersion of organisms. This mobility about the face may be responsible for pressure in susceptible areas and the consequent retardation of healing.

By no means of least importance is the circumstance that the mouth is constantly full of bacteria, and it is frequently more difficult to keep wounds therein sterile than to maintain sterility in other parts of the body. There is definite need, then, of an agent that will aid in the prevention and control of oral infection. The present communication deals primarily with this aspect of the problem.

Attempts to determine a course of therapy that would prove efficient in the management of postoperative wound healing turned us inevitably in the direction of the sulfonamides and, with a view to combating infection in the selective

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areas already mentioned, an expedient technic was evolved which, thus far, has seemed to afford substantial improvement over methods employed by us heretofore. It appeared preferable, for the present purpose, to confine the chemotherapeutic measures described herein to particular cases, which were carefully selected. This report is based on fifty-five cases, in soldiers and officers ranging in age from 20 to 56 years, who were given local sulfonamide therapy. Only surgical removal of deeply impacted teeth, difficult multiple extractions, removal of exostosed and non-vital roots and cysts, and operations in fields adjacent to structures or spaces conducive to the spread of infection were considered for this record. A control series of cases of similar nature was compared with the treated series. In many instances, chemotherapy was applied on one side after removal of bilaterally impacted third molars in the same patient, but not on the other side. Our results indicate that sulfonamide therapy markedly modified the course of infection.

PROCEDURE

A brief history was taken in each case. Care was observed in preoperative preparation, with strict adherence to the fundamental principles of sterility with regard to needles, instruments, etc. Surgical procedure was followed by thorough cleansing and débridement of the wound to remove fragments, spicula, bone dust (when burs were used) and necrotic and devitalized tissue. As soon as bleeding was minimal, a saliva ejector was inserted in the patient's mouth. Next, the wound was irrigated and rinsed with a 5 per cent solution of sterile sulfanilamide powder in warm (140° F.) distilled water, the solution being left in the area for at least two minutes, to wash away purulent exudates, superficial bacteria and any foreign matter that might not have been removed on excision of the tissue surrounding the wound. We used sulfanilamide powder because it is more soluble in hot solution than sulfathiazole. The field was then dried with sterile gauze and, by means of a powder atomizer, sterile powdered sulfathiazole was insufflated into the deep recesses of the wound and under the flaps. Use of this type of atomizer prevents lumping of the drug. The socket was not plugged up, but rather lined carefully with the sulfathiazole powder to permit adequate drainage and absorption of the concentrated chemical held in the blood clot, and to avoid the mechanically irritant property of a relatively insoluble compound.

Immediately after these steps had been taken, the wound was sutured and the suture line dusted with sulfathiazole powder. A gauze pad saturated with the 5 per cent sulfanilamide solution was applied to the area and the patient was instructed to leave this in place for one hour and to report any untoward symptoms. He was, moreover, advised not to rinse the mouth for a period of at least four hours, and then to proceed with the usual postoperative care. Best results were observed when the sulfathiazole powder was kept in the socket for forty-eight hours. The chemotherapeutic procedure was repeated after that time if necessary. Observations that the use of sulfanilamide in solution in irrigation of a fresh wound and the use of sulfathiazole powder in a spray are valuable aids in eliminating postoperative infection have been reported elsewhere.[1, 2, 3]

REPORT OF CASES

CASE 26.—Pfc. H. K., aged 23, March 8, 1943, presented a pulpitis in lingually malposed lower right first and second bicuspids. The lower first molar was badly broken down. An inferior alveolar injection of procaine was given and the teeth were removed surgically and alveolectomy performed to provide room for dental replacements. Sulfonamide therapy was instituted locally.

March 10: There was no swelling, with little bleeding and no pain.

March 12: Healthy granulation tissue was observed. The sutures were removed. There was no discomfort.

March 17: Under procaine anesthesia, the palatally impacted upper left second bicuspid, upper left first molar roots with cyst reaching as far as the schneiderian membrane of the antrum, partially erupted upper left second molar and impacted upper left third molar were removed. Alveolectomy was performed from the second bicuspid area to the tuberosity, to provide space for replacements. Five sutures were taken. Local sulfonamide therapy was carried out. The patient was confined to quarters.

March 18: There was no appreciable swelling and no sloughing, some bleeding and little pain.

March 20: Healing was satisfactory and the sutures were removed. Progress was excellent. The patient was given an appointment for March 30 for additional surgical measures, as he expected orders to a new station. On that date, under procaine anesthesia, the following surgical procedure was effected: removal of lower right cuspid totally impacted vertically, partially impacted birooted lower right lateral incisor, right lower temporary cuspid and molar, right lower malposed (linguoversion) second bicuspid, abscessed right lower first bicuspid and right lower first and second molar roots with extensive cystic area involving contents of the mandibular canal from first bicuspid to third molar. Alveolectomy was performed to provide space for dental replacements. Five sutures were taken. Sulfonamide therapy was applied locally. The patient was confined to quarters.

Twenty-four hours later, there was no swelling or trismus. There was slight tenderness, with little bleeding, and slight nausea, but no other systemic effects.

April 2: There was no sloughing and little discomfort. The sutures were removed.

April 6: With uneventful recovery, the soldier was assigned to his new post, his departure precluding final operation on the lower left side.

Comment.—This case was unusual because of the extensive operations performed in a short period of time. Except for the few days in quarters, the patient was able to perform his routine duties. The results were altogether gratifying.

CASE 49.—A/C A. R., aged 23, on examination, April 17, 1943, had a deep horizontal impaction of the left lower third molar, with a cyst. The left second molar was malposed. Under procaine anesthesia, the third molar and cyst were removed, with considerable trauma. Sulfonamide therapy was employed.

April 19: The postoperative results were: slight trismus and insignificant swelling and bleeding.

Comment.—This case is interesting because it illustrates our experience with a patient of the control series. An impacted lower right molar had been removed without difficulty a few weeks earlier. No sulfonamide therapy had been carried out. The patient had been incapacitated for some time, with edema, trismus, pain, elevation of temperature and other familiar sequelae of trauma in susceptible areas.

CASE 50.—Cpl. J. S., aged 26, April 13, 1943, under procaine anesthesia, had a horizontally impacted lower right third molar removed. There were embedded roots (lingual). The pterygomandibular space was opened, a tendinous portion of the internal pterygoid muscle being exposed. Local sulfonamide therapy was instituted. A drain saturated with 5 per cent sulfanilamide was inserted.

April 14: There was some trismus, with slight swelling and sore throat. The drain was removed.

April 16: The patient was feeling better. Additional local sulfonamide treatment was given.

April 18: The suture was removed. Progress was excellent.

Comment.—It may be stated that the pterygomandibular space, retropharyngeal space, tonsils, submaxillary glands, floor of the mouth, and veins of the lips, nose and face are all contiguous areas of the oral cavity in which the danger of infection and its rapid spread is ever present. In the course of the present investigation, it appeared to be strikingly exemplified that cautious prophylactic use of the sulfonamides can be of inestimable value in reducing the hazards of complications in these regions.

DISCUSSION

There is now ample evidence available of the usefulness of the sulfonamide

group of drugs employed topically in reducing the incidence of infection. However, certain substances that interfere with the bacteriostatic action of these agents deserve to be considered at this time. According to Woods,[4] even small amounts of para-aminobenzoic acid, regarded as an essential metabolite in the proliferation of organisms, exert an inhibitory effect on comparatively large quantities of sulfanilamide. Thus, as already pointed out, careful débridement and meticulous cleansing of a wound are essential. This is particularly true of wounds in the mouth for, as stated earlier in this communication, it is more difficult to keep the oral cavity sterile than other areas of the body, and there is need, therefore, of an agent to aid in keeping gross contamination to a minimum. Irrigation with hot sulfanilamide solution[3] serves to remove débris, purulent exudates, a great number of pathogenic organisms and those proteins hydrolysis of which produces para-aminobenzoic acid. Hence, reducing superficial infection as much as possible and saturating the specific areas with a concentration of sulfathiazole facilitate the task of the inherently resistant deeper tissues in warding off bacterial invasion, while the phagocytes and leukocytes complete the destruction of the harmful micro-organisms.

It has been demonstrated by *in vitro* experiments[5] that procaine is, in anti-sulfonamide action, similar to para-aminobenzoic acid. Recent studies *in vivo* by Major de Waal (R.A.M.C.) and his associates[6] have shown that although procaine does inhibit the bacteriostatic activity of sulfanilamide, only repeated large doses of this anesthetic have an inhibitory effect.

In dental operations, massive doses of procaine are rarely employed. Small and even repeated doses of procaine probably interfere very little with the therapeutic action of the sulfonamides. From our observations, procaine is excreted long before the concentration of locally applied sulfathiazole is appreciably reduced. At any rate, should it be proved definitely that procaine anesthesia is a handicap in sulfonamide therapy, there are other local anesthetics available that are not allied to para-aminobenzoic acid.

Regarding the toxicity of the sulfonamides in local applications as compared with oral administration, although more than ten times the concentration of the drug at the point of infection is possible, not enough is absorbed into the blood stream to give rise to harmful results.

A great deal has been written on the action of different sulfonamides on various species of bacteria, and the outcome is still confusing. Our reason for using sulfathiazole powder locally in the present work was that viable bacteria are thus exposed directly to a concentration of the drug at its saturation level for a longer period of time. Finally, for clinical problems such as those with which we were confronted, and to combat the antagonistic action of such agents as para-aminobenzoic acid and procaine, this method seemed most suitable.

Although our investigation was more concerned with prophylaxis, it may be worth while to say something about the systemic effects of the sulfonamides when administered orally (in conjunction with local application in cases of severe infection) or when applied to large areas from which absorption may occur, especially in those persons who do not tolerate the drug well. An experienced medical officer, aware of the harmful results of oral overdoses, should be in charge. Blood counts should be taken before and after administration of sulfonamides for evidence of toxic effects, and blood levels should be checked. A diminution in either the white or the red blood cell count is a danger signal. Urinalysis for signs of renal disturbances should not be overlooked, and the well-known toxic symptoms of nausea, vomit-

ing, dizziness, rash, peripheral neuritis, etc., should be kept in mind.

This report was not prepared with the idea of making a case for the sulfonamides, but to encourage further advances in the knowledge of these therapeutic agents. Indeed, their routine use in fresh, clean wounds may be contraindicated. If, however, the sulfonamides prove to be of benefit along the lines suggested, methods may be devised for their use in traumatic war wounds of the mouth and adjacent areas, especially if injury of bone has complicated the case. It appears to remain for this war to give enlightened consideration to and clarification of the whole question.

SUMMARY

Local application of the sulfonamides proved to be an effective prophylactic measure in those areas in the mouth where the spread of infection is accelerated by fossae, lymph channels, glandular tissue and veins about the face that are lacking in valves and the walls of which are somewhat rigid.

The inhibitory effect of para-aminobenzoic acid on the bacteriostatic action of the sulfonamide group of drugs can be reduced by thoroughly ridding the wound of purulent material and by irrigation.

Sulfathiazole, since it is a fairly insoluble agent, is present in saturation long after procaine is excreted. At any rate, the action of the small dose of procaine employed in dental operations does not appear to neutralize the beneficial action of sulfathiazole.

Pain, trismus and edema were less prevalent, or present in a milder form, in a treated than in a control series of patients.

Formation of healthy granulation tissue followed more rapidly under local sulfonamide therapy.

Toxic symptoms and sloughing were negligible, even though two or three applications were made in severe cases in order to maintain an optimal concentration of the drug at the point of infection.

Following sulfonamide therapy, in a total of fifty-five cases studied, two cases of dry socket were observed. Two patients experienced mild nausea. Four had moderate bleeding.

BIBLIOGRAPHY

1. ADAMS, F. R.: Hot Solutions of Sulfonamides. J.A.D.A., 30:58, January 1943.

2. MEACHAM, P. L., and OSGOOD, E. E.: Efficacy of Local Use of Sulfathiazole Powder in Dentistry and Oral Surgery. J.A.D.A., 28: 1640, October 1941.

3. GREEN, H. N., and PARKIN, T.: Local Treatment of Infected Wounds with Sulphathiazole. *Lancet*, 2:205, August 22, 1942.

4. WOODS, D. D.: The Relation of *p*-Aminobenzoic Acid to the Mechanism of the Action of Sulphanilamide. *Brit. J. Exper. Path.*, 21: 74, April 1940.

5. KELTCH, A. K., *et al.*: Anti-Sulfapyridine and Anti-Sulfathiazole Effect of Local Anaesthetics Derived from *p*-Aminobenzoic Acid. *Proc. Soc. Exper. Biol. & Med.*, 47:533, June 1941.

6. DE WAAL, H. L.; KANAAR, A. C., and MCNAUGHTAN, JEAN: Antisulphanilamide Action of Procaine *in vivo*. *Lancet*, 2:724, December 19, 1942.

THE NAVY PREDENTAL PROGRAM

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THE following information concerning the Navy Predental Program has been received from the Bureau of Medicine and Surgery, and is published at the suggestion of Capt. Robert S. Davis (DC), Navy Dental Corps, Washington, D. C.

The Navy V-12 Program, which became effective July 1 with units established in 131 colleges and universities and in approved medical and accredited dental schools throughout the nation, is designed to protect the source of officer candidates and to produce a continuous supply of officers for the several branches of naval service.

Undergraduate V-12 units, eighty-nine of which include quotas of predental students, conform to certain general policies and regulations. The students live in college dormitories and fraternity houses, selected and approved by the Navy, eat together in Navy messes, follow curriculums prescribed in full or in part by the Bureau of Naval Personnel and, except for members of the N.R.O. T.C. and men enlisted in Marine Corps Reserve, Class III(d), are uniformed as apprentice seamen. All students in the V-12 Program, including medical and dental students, receive the pay and allowances of apprentice seamen on active duty.

The primary purpose of the Navy V-12 program is education. Military discipline and procedures are kept to a minimum consistent with the successful operation of a naval activity, as most V-12 students will receive specialized naval training later while attending the indoctrination schools or in naval training schools. Hence, the undergraduate phase of the V-12 program, by preserving, as far as possible, the normal pattern of college life, protects predental students in the early stages of their education, permitting them to pursue their studies without undue distraction.

There are approximately 6,500 Navy preprofessional students assigned to eighty-nine universities and colleges throughout the country. They are scattered through the various years of preprofessional education. The predental students for the V-12 Program were selected with procedures similar to those used for other students. Students who entered the program July 1 came from three sources:

1. The enlisted reserves constituted the first group. These were enrolled in the predental curriculums in colleges and universities approved for the V-1 program. The members of this group who were near the end of their fourth semester of work or who had completed four or more semesters were given a comprehensive achievement examination late in April. Students standing in the lowest 10 per cent of the distribution of scores on this examination were eliminated. The remaining students were permitted to continue with their predental courses or to enter a dental school, provided they were accepted for admission.

2. The second group of students came from the enlisted men in service. These students were selected on recommendation of their commanding officers, provided they had attained a specified minimum score on the General Classification Test.

3. A third group of students were selected directly from civil life. These were chosen in terms of a rigid screening procedure which included (a) a scholas-

tic aptitude test given at approximately 18,000 centers throughout the country, (b) a physical examination, (c) an interview by a naval officer in the Office of Naval Officer Procurement and (d) final selection by a committee of three, including a naval officer, a business man and an educator. This committee considered all the information available on each applicant. From those finally selected for the V-12 Program, only the highest ranking students with a preference for predental training were admitted to the predental curriculum.

The predental curriculum was worked out on the basis of past practices in colleges and universities. It is generally believed that it represents the best type

OUTLINE OF NAVY PREDENTAL CURRICULUM

First College Year	Periods per Week 1st Term	2nd Term
Chemistry I, II (C1,2)	4 (6)	4 (8)
Physics I, II (PH1,2)	4 (6)	4 (6)
Mathematical analysis I or III, II or IV (M1 or 3, 2 or 4)	5*(5)	5*(5)
Modern foreign language I-II (L1,2)	3 (3)	3 (3)
Naval organization I, II (N1,2)	1 (1)	1 (1)
	17 (21)	17 (23)
Physical training	18 (9½)	17 (8½)
	35 (30½)	34 (31½)

Second College Year	Periods per Week 1st Term	2nd Term
Chemistry III, quantitative analysis (C3)	4 (8)	.....
Organic chemistry I (C4)	.....	4 (8)
Biology I, II (B1,2)	4 (8)	4 (8)
Modern foreign language III-IV (L3-4)	3 (3)	3 (3)
English I-II (E1-2)	3 (3)	3 (3)
Historical background of present war I-II (H12)	2 (2)	2 (2)
Psychology I, general (PS1)	2 (2)	2 (2)
	18 (26)	18 (26)
Physical training	17 (8½)	17 (8½)
	35 (34½)	35 (34½)

Third College Year	
Biology III (embryology or biology IV [comparative anatomy] (B3 or 4)	5 (9)
Organic chemistry II (C5)	4 (8)
Modern foreign language V or VI (L5 or 6)	3 (3)
Psychology II, abnormal (PS2)	3 (3)
Elective	3 (3)
	18 (26)
Physical training	17 (8½)
	35 (34½)

Figures in parenthesis indicate contact hours per week in class and laboratory. Figures outside parenthesis indicate the number of meetings per week in class and laboratory.

*Mathematical analysis I and II, combination course in mathematical analysis for students entering with 2 or less units of mathematics. Mathematical analysis III and IV, algebra, trigonometry and analytic geometry or analytic geometry and calculus for students entering with 2½ or more units of mathematics.

of predental education that has been offered at colleges and universities. It extends over five terms of sixteen weeks each, a total of twenty months of predental preparation. A detail outline of the curriculum is presented in the accompanying table. Course descriptions are given in detail in Bull. 1 "The Navy College Training Program, V-12 Curricula Schedules," issued by the Training Division of the Bureau of Naval Personnel of the United States Navy, Washington, D. C.

Further screening of the predental students will be done on the basis of scholastic records and comprehensive achievement examinations. An achievement examination similar to that given late in April of this year will be given to other students from the V-12 group during the fourth term of work. Also students entering the prescribed predental curriculum directly from civil life will be given an achievement examination near the end of their first two terms. Final selection of students for dental schools will be made in the following manner:

1. The dental and predental schools located in different sections of the country will be grouped according to their location in the various naval districts.

2. A selection committee composed of the deans of the dental schools or their representatives in each naval district, together with the director of training of the district, will be charged with the responsibility of selecting qualified predental students for entrance into dental schools.

3. A reciprocity agreement will be established between these screening committees in the various districts so that, in the event of an excess of qualified predental students in one district, such excess may be assigned to districts where a deficiency may exist.

4. The predental students after completing their third term of predental training should submit their requests for dental training via their commanding officers to the screening committee in the appropriate naval districts. Applicants will have the privilege of designating three choices as to their preference of dental schools. This preference will be honored so far as practicable, but will be conditioned by the Navy quota in the individual dental school and the student's standing on the list of qualified candidates to be prepared by the screening committee. Due consideration will be given to the period between completion of predental education and matriculation in the chosen dental school.

5. Predental students who are selected as qualified for entrance into dental school will be assigned to such schools upon completion of their prescribed predental training. Should there be an interval of several months before matriculation is possible, the predental student may either continue predental work in subjects that will further fit him for dental training or be assigned to a naval hospital for the interval to duty under instruction in the laboratory fields of dentistry.

6. The director of training for the naval district in which the dental school is located will act as consultant member for evaluating officer-like qualities, as well as secretary of the dean's screening committee, and be the intermediary between the commanding officers of Navy V-12 Units and the committee, as well as between the committee and the Bureau of Medicine and Surgery and the Bureau of Naval Personnel. In this capacity, his duties will be to call the deans together for the purpose of forming the screening committee, and for outlining the policies and method of functioning of the committee. He will inform the commanding officers of V-12 dental units of the credentials desired by the committee of deans and arrange for personal interviews with applicants wherever practicable either at the Navy V-12 institution or at any other acceptable location.

THE JOURNAL *of the* AMERICAN DENTAL ASSOCIATION

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December 1 *Editorial Department* 1943

THE WAGNER-MURRAY-DINGELL HEALTH SERVICE BILL

NEXT to the relations of the dentist to the Army and Navy Dental Corps, the question of the relation of the dentist to the public in the postwar period attracted most attention and discussion at the recent meeting of the House of Delegates of the American Dental Association in Cincinnati.

It seems inevitable that the present trend toward socialization of health service will compel the adoption of some plan or program of public health service, if not before the end of the war, at least in the days following soon thereafter. The politico-social trend the world over appears to point directly toward a change in the present methods of rendering health service embodying the new conception of the obligation of the government in the preservation and maintenance of the health of the individual.

The specific form in which this obligation has expressed itself is in the introduction into the present Congress of the social security bill known as Senate Bill 1161, introduced conjointly in the Senate and

House of Representatives by Senator Wagner, Senator Murray, and Representative Dingell. The bill embodies a carefully thought out plan of health service which conforms to the latest political doctrine of guaranteeing to the individual social security from the cradle to the grave—a paternalistic system that will place even the health care of the individual under the supervision and direction of the governmental administration, with those who are actually administering the service playing a subservient part.

The Wagner Bill, S. 1161, was much discussed at the recent meeting of the House of Delegates at Cincinnati, and while practically no provision is made for dental service in the bill, it is assumed that any health legislation that attempts to provide comprehensive health service must, in the nature of the case, include dental health service. It is for this reason that the Association was much concerned with the provisions of the Wagner Bill, namely to include in the health program dental service that would be commensurate with a broad health service.

The question of health insurance as proposed by the Wagner Bill was presented to the House of Delegates by the Committee on Legislation, and only on count did the Wagner Bill meet with the approval of the House of Delegates, namely, the basic principle of improvement of national health. After considerable discussion the House formulated its concrete dissension in the following resolution:

> The House of Delegates of the American Dental Association, while endorsing the basic principle for the improvement of national health, must oppose the program of Senate Bill 1161 because of the eight principles which were adopted by this body in 1938.
>
> If legislative progress dictates a reconsideration of the dental aspects of Senate Bill 1161, the Board of Trustees is directed to take necessary steps consistent with the actions of this House, or to convene the House of Delegates in special session in order to protect the interests of the public and of the profession.

The eight principles adopted by the Association as the basic principles upon which any national health program should be projected are:

> I. In all conferences that may lead to the formation of a plan relative to a national health program, there must be participation by authorized representatives of the American Dental Association.
>
> II. The plan should give careful consideration to: first, the needs of the people; second, the obligation to the taxpayer; third, the service to be rendered; and fourth, the interests of the profession.
>
> III. The plan should be flexible so as to be adaptable to local conditions.

IV. There must be complete exclusion of non-professional profit-seeking agencies.

V. The dental phase of a national health program should be approached on a basis of prevention of dental diseases.

VI. The plan should provide for an extensive program of dental health education for the control of dental diseases.

VII. The plan should include provision for rendering the highest quality of dental service to those of the population whose economic status, in the opinion of their local authorities, will not permit them to provide such service for themselves, to the extent of prenatal care, the detection and correction of dental defects in children, and such other service as is necessary to health and the rehabilitation of both children and adults.

VIII. For the protection of the public, the plan shall provide that the dental profession shall assume responsibility for determining the quality and method of any service to be rendered.

At long last it appears that the American Dental Association has been awakened to the seriousness of the political situation as related to national health insurance and legislation therefor, and realizes the necessity for a more active part in the formulation of plans and programs for the health care of the public. The attitude of the dental profession for some ten years now has been to sit on the sidelines and observe the efforts of the medical profession in endeavoring to stem the trend toward health insurance.

While the medical profession has been quite active in endeavoring to safeguard its own interests, we are convinced that whatever is done for the real interests of dentistry will have to be done by dentistry itself. A striking example of the general indifference toward the interests of dentistry is furnished in the drafting of the present bill. Dentistry is shunted aside—not even treated as a health service—until it is determined how the act will affect medical health service; then the political powers will or may consider dentistry. Well, when that is determined, dentistry will be *told* the part she will play in the national health program rather than being consulted toward determining its course.

We hold no brief for socialized health service, but in the present state of the public mind toward changes in our social life, it does not appear politic to oppose any and all changes leading toward a national health program, but there is still time for the profession to devise ways and means of controlling the changes, at least so far as dentistry is concerned.

The main deterrent to action on the dental phase of the health prob-

lem is the almost prohibitive cost of a nation-wide dental service; and that holds forth the prospect that our phase of the problem will almost necessarily have to be dealt with on a separate and distinct basis. But the fact remains, it should and must be dealt with and certainly at the same time that the present comprehensive program is being planned.

Anent the political phase of this most important humanitarian movement, many are of the opinion that national health security is a brain child of the present governmental administration; but such is not the case. As far back as 1929, President Hoover, with the germ of the present movement in mind, called the White House Child Health Conference with the thought of formulating a plan or national program of health service for the children of the nation. This conference discussed broadly the problems of national health service and inaugurated then the thought and the machinery which has eventuated in the present forward state of this worthy humanitarian movement.

And, incidentally, may we note that dentistry as an institution of health service had a very prominent part in this first health conference. The turn which the subject has taken toward socialization of health service is entirely a subsequent political expediency.

For some twelve years now we have watched the trend toward social security throughout the world and particularly in this country so far as it relates to the health welfare of the nation, and we have on various occasions strongly urged the profession to heed the trend toward socialization of health service. We do not recount this progressive trend of thought toward socialization of health service merely to indulge in the "we told you so" type of argument, but primarily to create another occasion for stimulating an alertness on the part of the profession that will result in measures of preparation for what we consider inevitable, if ominous, changes in the administration of public health service; and to be prepared with a plan that would meet the situation if the government plan were not satisfactory.

INDEX FOR 1943

THE Index for Volume 30, 1943, will be published this year separately from THE JOURNAL and will be supplied without cost to all members of the Association upon request.

The Index is being published in this manner in an effort to aid the Government in the conservation of paper.

A request slip for the Index appears on page A-55 of the Advertising section, and we urge all who wish copies of the Index to send in the request slip promptly. Requests without the slip, however, will also be honored.

BIBLIOGRAPHICAL

Enameloid Acrylics in Dentistry.

By MAURICE N. STERN, D.D.S. Credo Publishing Co. 140 pages. Price $4.

THIS book deals with the relatively new field of methylmethacrylate resins as applied particularly to the construction of inlays, crowns and bridges. One short chapter is devoted to the building of removable bridges and partial and complete dentures.

In Chapter II, in discussing the physical and chemical properties of the methyl methacrylate resin, the author makes comparisons with other resins and describes the properties that make it superior to these resins. A comparison with present-day accepted materials might have aided considerably in evaluating its physical properties as applied to its use for filling materials, crowns and bridges. The author does assert that the resins have qualities superior to those of porcelain. Time will tell whether this is true. Furthermore, the accuracy of a number of statements regarding the physical properties of the methyl-methacrylate resins is subject to question.

The author claims that a bulky mesioclusodistal box-type preparation, with no slices, bevels or narrow isthmuses, when handled as described in his book, will give permanently satisfactory results. The short period of time that this material has been employed for such uses has certainly not yielded enough evidence to permit the author to make such a positive statement.

Dr. Stern is aware of the inherent weaknesses of resins and has consequently suggested modifications in cavity preparation and cementation to help compensate for such deficiencies. He has described quite well the investing, sizing and sealing of molds and pointed out numerous possible causes for failure, with methods for correcting or avoiding these.

This book should be an excellent addition to the library of those dentists who are interested in making restorations of the methyl methacrylate resins, but it should be remembered that these resins are not to be indiscriminately used while much is still to be learned about them.

CARL W. GIELER.

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PRESIDENT'S ANNUAL ADDRESS

J. Ben Robinson, D.D.S., Baltimore, Md.

IN appearing before you at this time, I do so not merely because the By-Laws stipulate that the President "shall deliver an address at the general sessions," but because the time and the place offer opportunity to discuss with the elected representatives of American dentistry certain questions which are of vital importance to the usefulness of dentistry in the years that lie immediately ahead.

I would be most ungrateful were I not to express my deep appreciation to dentists in all sections of the United States for their loyal support of my efforts during the year. I have been in reasonably close contact with the work of the state officers, and in intimate contact with the activities of the officers and the committeemen of the American Dental Association. I have been deeply impressed by their earnestness, their diligent efforts and their unremitting zeal in serving their profession and the war effort so ably. Their devotion to their professional responsibilities and their loyalty to their country will ever stand as a striking testimonial to their worth as true professional men and citizens.

We are told by responsible military authority that we are now in the final phase of the war. This report encourages us in the hope that we may return soon to peaceful pursuits. Most of us assume that this return to normal conditions will be simple and easy, and that the social setting from which we were removed when war came will be restored. There is little justification for such an optimistic view. You and I and the society in which we live have felt too deeply the struggle through which we have passed to be able to throw off its effects so easily. The changed social conditions which we have experienced during recent years and the added force given them by the stress of war have definitely altered our economic, social and professional concepts. We are now confronted with the early task of adjusting ourselves to these changes. There will soon be the need for a return of men and materials to civil pursuits, a reconstruction of our way of life back to standards suitable to the happiness and prosperity of a free people and a reorganization of our institutions so as to provide services essential to the needs and desires of a contented society.

Dentistry is a part, and an important part, of this challenging picture. It has not been able to elude the forces of destruction, and it will not be able to escape unscathed the penalties that they have imposed. As an integral part of modern society, dentistry was drawn into the conflict and has shared the burden of winning the war. As an essential participant in the war, it must intelligently and seriously plan to assume its full responsibility in meeting the problems of postwar conditions.

Among the questions of concern with which we must contend in the days that lie immediately ahead is that of the socialization of health services. The growing belief among our people that medical and dental care should be available to all the population, and the general admission that all members of society are

Presented at the annual meeting of the House of Delegates of the American Dental Association, Cincinnati, Ohio, October 11, 1943.

entitled to health service, have prepared the public mind to favor the early adoption of a socialized plan of health care for all the people.

The socialization concept is not new or ultramodern. The movement here began about sixty years ago, and has periodically been given impetus by the frequent deliberations of health congresses, by researches in sociology and in public health and by the force of increasing public opinion and deliberate official sanctions. Local and state departments of health have for years continued to expand their facilities through increased local appropriations, supplemented since 1935 by grants-in-aid from Social Security funds. Evidence of the persistence of the effort to secure adequate health care for all groups of the population is to be observed in the multiplication of prepayment plans—some promoted by private endeavor, others sponsored by the Federal Government. These manifestations constitute in the aggregate a solid base upon which a national socialized health structure may now be superimposed.

In the past, Dentistry's place in the general health movement has not been so secure nor its participation so effective as its importance merits. In fact, the indifference frequently manifested toward public dental health in some sections of the United States raises the question, Why has it not been more readily recognized? As early as the middle of the eighteenth century, oral health was stressed by dentists and physicians alike as an essential factor in general health. The modern oral hygiene programs, the foci of infection campaigns and the caries control movements have been advanced as effective contributors to general health. In some sections of the United States, adequate public dental health programs have been established; in other sections, too little has been accomplished. In many instances, dentistry has had to combat the prejudices of medical health administrators who have taken the narrow view that public dental health is not essentially comprehended in public health philosophy. This insecure position of dentistry in the public health pattern presents a serious situation for our dental leaders to correct.

The evolution of the socialization concept has brought us finally to the practical consideration of a pointed proposal to socialize completely the health services on which the people of the United States depend. There is now a bill in the Senate of the United States, known as Senate Bill 1161, which is designed "to provide for the general welfare; to alleviate . . . premature death, disability, and sickness. . . ." While Senate Bill 1161 is presumed to provide for a complete health service, it fails to provide for any dental care as such. It recognizes the existence of dentistry, but postpones until a future date any consideration of the place that it shall occupy in the social security program. Though dental health benefits are not defined in the bill, it is reasonable to conclude that, by implication, the act comprehends the treatment of certain dental disorders. This conclusion seems justified on the grounds that a comprehensive health program cannot operate satisfactorily in the interest of its beneficiaries without providing for the treatment of acute oral infections and of oral trauma. Perhaps the sponsors assume that emergency dental services can be delivered by the specialist group defined in the bill. The language of the act, however, cannot be interpreted to include the dentist as a "specialist" because "the term 'special medical benefit' means necessary services requiring special skill or experience, furnished . . . by a legally qualified physician." Obviously, then, if the beneficiary is to receive emergency dental care under the provisions of the bill, it must be assumed that the physician will furnish it—a service which the physician is not equipped by either edu-

cation or experience to render. The special therapeutic procedures developed through the years by dental practice and dental research have been ignored by the medical curriculum; hence, medical graduates lack both knowledge and skill in this special field.

Senate Bill 1161 provides finally that "The Surgeon General and the Social Security Board jointly shall have the duty of studying and making recommendations as to the most effective methods of providing dental, nursing and other needed benefits not provided under this title." When one ponders this provision in the light of the definition of "specialist," there is no disputing the intent of this bill currently to disregard dentistry as an essential health service.

There are many valid objections to be registered against Senate Bill 1161. From the standpoint of dentistry, the first objection is the failure of those who drew the bill to include in it a provision for the dental specialist and a definition of "emergency dental health care." The dental profession should insist vigorously that the duties of the dental specialist be included and defined in the measure *now* so that, in the event the bill or any modification of it becomes law, oral health benefits will be immediately guaranteed the beneficiaries under the plan. My plea is not for Senate Bill 1161, or any similar bill so vast in its possibilities. I argue for the proper recognition of dental health care in *any* socialization program seriously pretending to provide for the health needs of all the people. Unless public dental health is competently represented by the dental specialist in any plan that is proposed, dental care cannot be effectively provided for. The time has not been when even the most astute physician could plan and execute, without the aid of the dental specialist, a competent health or educational program for dentistry.

A second general objection to the bill is that it has not had the benefit of guidance that should be offered it by leaders in the medical and the dental profession. It is not enough to say that the National Advisory Medical and Hospital Council answers this purpose. The best interests of the public require that the medical and dental professions shall occupy a prominent place in the planning of any scheme of socialization of the health services that may be promulgated under the sponsorship of government, and that the direction of such a movement shall rest largely upon the judgment of leaders in the professions. They understand both the over-all and the intimate aspects of the health program in all its implications and complications much better than laymen, and they are fully capable of extending their thinking into the fields of sociology, economics and administration, in such a fashion as to render sound judgment on proposals for change. Unfortunately, there is a tendency in certain political quarters to impugn the motives and the integrity of the organized professions. The assumption is that they are vested interests and, because they are engaged in health work as a vocation, it is alleged that they are concerned only with their personal interests and, because they are organized, their motives are selfish. Such conclusions are absurd. The professions are qualified educationally and temperamentally to engage satisfactorily, effectively and ethically in planning for any federal or state health project that may be desirable.

Immediately after the close of the war, approximately 20,000 dentists will be released from duty and returned to civilian pursuits. Most of these dentists will want to enter or to resume practice as soon as possible. The six or eight thousand recent graduates included in this number present two problems that will not solve themselves: namely, the need for dental equipment with which to begin their practices, and the need for refresher courses to prepare them better

to meet the problems of private practice.

THE WAR SERVICE COMMITTEE

The situation with respect to equipment has been watched closely by the War Service Committee, and an effort has been made to ensure a sufficiently large reserve stock to meet the needs of postwar distribution. Not only is there an immense reservoir of young men who will require equipment, but also there are many dentists who for four years have been denied necessary replacements and are now in dire need of new equipment. It is estimated that there will be a potential market for about 10,000 complete equipments should the war end next year. Unless a strong effort is put forth to bring about changes in the present production program, there will be no stock pile on hand to meet this heavy demand.

Recently, it was announced that the equipment needs of the Army and the Navy will soon be satisfied. But the policy of the War Production Board restricting the use of critical materials to the manufacture of dental equipment for military purposes only continues in operation. Since practically all military needs for dental equipment will have been satisfied by January 1, 1944, the dental manufacturer will soon be obliged to close his factory unless the War Production Board regulation is so changed as to allow him to begin production for civilian needs. If the manufacturer is not permitted the necessary materials to enable him to continue operations in order to build up a reserve, there will be no source of supply from which returning dentists can secure the needed equipment, and they will be obliged to wait on manufacture—some of them for two or three years. This situation is really more critical than it appears and calls for the continued vigilance of the War Service Committee.

Numbers of young men now in the armed forces have made inquiry about refresher courses that might provide opportunities for a review of those technical procedures not generally practiced in Army service. It is pointed out that the younger dentists feel keenly the need for some additional instruction and experience before they return to private practice. If there is an appreciable demand for this type of postgraduate instruction, it will be necessary for the dental schools to provide the instruction and the facilities to satisfy the demand. Reasonably accurate information should be secured to show what the effective demand may be; and the dental schools, under the guidance of the Council on Dental Education, should be asked to make provisions to meet this important demand.

DENTAL LICENSURE

Some of the returning dental officers may present a problem respecting licensure that will question the integrity of our state dental laws. I regret to say that many inquiries have come to me from dentists in the service as to whether the American Dental Association would favor a plan by which discharged dental officers might practice in the state of their choice without observing the formality of taking the state board examination. Some of these letters were couched in a severe tone, indicating a determination to test every possible means of securing the privilege. In every instance, I replied courteously, but firmly, that such a proposal would be looked upon unfavorably, and pointed out the necessity for a continued strict observance of state dental laws and the impracticability of conferring special favors on any part of a professional group for any reason. The attitude of these men toward licensure is important because it is a threat to our system of state laws, which the dental profession has patiently built up over the past one hundred years and

which has been an effective safeguard to standards in dental education and dental practice.

A number of appeals have come to me requesting the American Dental Association to give special consideration to the licensing of refugees who have fled to this country from persecution and threat of death in Europe. To all such inquiries, I replied that, in my opinion, the American Dental Association would vigorously oppose any movement tending to lower standards in dental education and practice, which would be necessary for compliance with this request. I based my decision on the belief that, it would be your opinion, the time has not yet arrived when the need for additional dentists in the United States calls for a lowering of dental educational standards. We still require the American boy to meet the traditionally high standards of quality in dental education as formerly, and I am sure you do not want to see the standards for the American boy fixed on one level and those for the citizens of another country placed on a lower and more convenient level. Such discrimination would be contradictory to democratic ideals. I have reminded these folk that America has opened its doors to the oppressed and has given them an opportunity to rehabilitate themselves in line with American standards, and have expressed the conviction that the great majority of them are too grateful for the helping hand to ask for special privileges.

The many problems that the war conditions have imposed on the dental profession, including the impending return to normal pursuits of large numbers of dentists from duty in the armed forces and the possible effect of their impact on the character of the dental profession, are sufficiently acute and important to require special study by this Association before the end of the war. I would recommend either a special committee for the purpose or the designation of the chairmen of a number of standing and special committees to work together in making a study of postwar problems and to plan for assistance to be provided in the reorientation of those who are soon to return to civil life.

PAN AMERICAN RELATIONS

During the past year, the Pan American Committee has been quite active in promoting a stronger feeling of friendship between the members of the profession in the countries of this hemisphere. It sponsored an emissary to the countries of South America and it encouraged numerous members of this Association to attend the Fourth Medico-Dental Convention held in Mexico City in March. It has arranged scholarships for many Central and South American dentists, who have been subsidized by our state department and who have come to this country for the purpose of pursuing postgraduate courses in our institutions of dental learning. This activity is stimulating an ever-increasing number of Latin Americans to complete their dental education here. The encouragement and the assistance provided this educational program by the Pan American Committee, with the cooperation of the Division of Cultural Relations, Department of State, have been among the most important achievements of the American Dental Association during this administration.

I have been rather close to this picture and have had an opportunity to observe intimately the attitude of the people of Mexico and Central America toward the people of the United States. I have discovered that our neighbors to the south have explicit confidence in our health service groups and our purely scientific organizations. It is obvious that, because of this confidence, these agencies can do much more in forging bonds of friendship between the countries of this hemisphere than can be done through our aggressive industrial and commercial in-

stitutions. The Hon. Cordell Hull, Secretary of State, commenting upon the report of activities of the Pan American Committee, said:

> This report reveals the steady advance you and your colleagues are making in promoting closer relations among the dentists of the hemisphere and thus contributing in no small measure to that international understanding which is fundamental to world peace. It is a source of satisfaction to me that the Department is able from time to time to furnish assistance and encouragement to your efforts.

The future holds many opportunities for this Association to support the spirit of true internationalism and the principles of world peace. American dentistry can lay just claim to preeminence in the field of oral health among the nations of the world. Because of its prestige and the quality of its professional programs, it is in a position to be of service to all countries. The American Dental Association should not, in my opinion, limit its foreign policy to the countries of South America, but should plan to extend support and guidance to any nation of the globe that may seek such aid.

In many countries, there is a loyal and determined effort on the part of dental leaders to advance the quality and quantity of dental health care. In the case of China, Dr. David S. K. Dai, who is in attendance at this meeting, has outlined to me his plan for inaugurating the American system of dental education and practice in his country. He informs me that there are only 320 educated dentists in China available to care for a population of four hundred and fifty million people. When I asked what prompted him to attempt such a formidable and seemingly hopeless task, he said: "I have faith in my people and hopes for their future. I want to contribute substantially to the strong foundations of a good public health system that will one day in the fuure provide adequate dental care for all the people of China." When a man has the courage and faith to attack a problem of such proportions in the spirit that Dr. Dai has exhibited, a great country and a great profession like ours can do no less than make its resources available to him for whatever use he may have in mind. I recommend that the name of the Pan American Committee be changed to the Committee on International Relations, that this Association may be in a position to assist through the medium of our government or otherwise any country that may request its aid.

THE DENTAL CORPS OF THE ARMY AND NAVY

I have mentioned the many letters that have come to me from Army and Navy dental officers stationed in all parts of the world. The predominating theme of these letters has been the unfavorable status occupied by the officers of the Dental Corps with respect to the officers of the Medical Corps. It is the firm belief of those who have expressed themselves that the positions of the Dental Corps in the present plans of organization of both the Army and the Navy are neither just to the dental officers nor conducive to their facile and efficient functioning in the interests of the armed forces.

It is obvious that, in some instances, the complaints concerning rank are not valid, that the objections are not made because of the unfavorable status the Corps occupy or in the interest of the common good, but rather because of personal resentment engendered by the unsatisfactory grades held by the complainants. On the other hand, there are good and sufficient grounds for much of the resentment that has been expressed. In fairness to most of the objectors, I can say that the primary purpose of their complaints was to call attention to conditions that are injuring the morale of the officers and militating against the efficiency of the Dental Corps. Their

purposes in writing were unselfish and were meant to be truly constructive.

Dental officers should not be subordinated to unjust regulations which prevent promotions earned on merit and justified by function. Such a circumstance tends to dull incentive and to reflect generally upon the quality of the service rendered by the Corps. Such a circumstance results in humiliation to the dental officer and engenders antagonism between the Dental and the Medical Corps. The consequences of such conditions are not good either for the Dental Corps or for the dental profession. In 1917, the Congress, at the request of the dental profession, passed a law establishing parity in military grade between the officers of the Medical and Dental Corps in order to ensure justice, to reward merit and to promote quality service. It is to be regretted that this law is now disregarded.

Frequent appeals have come to me requesting that the American Dental Association use its influence to increase the authority of the officers of the Dental Corps in the administration of its affairs. It has been pointed out time and again that the positions occupied by the Dental Corps in the plans of organization of the Army and the Navy effectively and completely subordinate the dental officer to the command of the medical officer. This illogical planning requires that orders issued by the dental officer in matters pertaining purely to dental requirements must be reviewed and even revised by the medical officer. In many instances, the medical officer, lacking understanding of the importance of a dental order, fails to cooperate promptly or fully, and thus hinders the dental officers in the performance of their functions. It is also pointed out that the Supply Division of the Surgeon General's Office and the various medical depots are under the command of medical officers and, in most instances, have no dental officers on the staffs to assist in meeting the technical dental requirements. In this situation, the medical officer is responsible for all supplies, including requisition for procurement, requisition for issue, warehousing, inventory and general distribution. I can say, with intimate knowledge, that one of the reasons for the continuing shortage and, in some instances, the total lack of dental equipment suffered by the Dental Corps in the early days of the war was the inefficiency of the medical personnel who were handling dental supplies. It is alleged that this situation continues to hamper the operation of dental clinics in the various stations. It is to eliminate these unnecessary hindrances that dental officers everywhere are appealing for more authority for the Dental Corps. The difficult position of the Dental Corps with respect to rank and authority is ably set forth in two editorials in *Oral Hygiene*, in the August and September issues. If you haven't read them, I commend them to your attention. They are accurate in content and frank in expression.

Because of the embarrassment created by the current plans of organization under which officers of the Dental Corps must work, large numbers of officers and an increasing number of private practitioners are insisting on complete autonomy of the Dental Corps; that is, the complete separation of the Dental Corps from the Medical Department. In considering such a proposal, it must be borne in mind that the Medical Department of the Army and the Bureau of Medicine and Surgery of the Navy are designed to care for the health of the armed forces. The Medical Department of the Army consists of six corps: Medical, Dental, Veterinary Medicine, Nursing, Sanitary Engineering and Pharmacy. Because of organizational difficulties, there is reasonable doubt that the Dental Corps could be removed from its natural relationships with other health groups and be effectively established as

an independent department. And even if such a plan could be effected, there is reasonable doubt of the wisdom of isolating one branch of health service from five other related branches. It is, therefore, the opinion of some that the Dental Corps should remain an integral part of the Medical Department with an autonomy guaranteeing parity in grade between the officers of the Dental and Medical Corps and authority permitting the Corps freedom in administration necessary for it to function with the greatest possible efficiency. If these reforms can be satisfactorily achieved by modifying existing regulations, all well and good. If reforms cannot be ensured in this manner, specific legislation should be resorted to. I would recommend that this House of Delegates go on record as respectfully requesting the Surgeons General of the Army and the Navy and their superior officers to authorize such changes in their plans of organization as will ensure greater freedom of action to dental officers in administering the affairs of the Dental Corps.

THE DENTAL LIBRARY

The dental library, with its collection of scientific material and its facilities for serving the profession, has become one of our most valuable and important aids to individual and collective professional study. The modern dental student has learned to depend on the library, and the graduate dentist finds it the most convenient and efficacious means of improving his knowledge and skill. The literature of a profession is accepted also as a criterion by which scientific bodies and other learned groups may judge the quality of the profession. Because of these considerations, it is incumbent upon the American Dental Association to develop to the fullest the scope and usefulness of its Library and Indexing Service.

An earnest effort was made recently by the Committee on Library and Indexing Service, the Board of Trustees and the House of Delegates to improve the library services now sponsored by the A.D.A. This effort was based on a study and recommendations made by a competent standing committee consisting of four members of this Association and three well-known dental librarians. Unfortunately, personalities have been permitted to obscure the fundamental issues involved. This agitation of personalities has created a situation so unfavorable to the growth of an important function of the A.D.A. that I feel in duty bound to comment on it before this House. The interest that I have taken in the issues involved and the comments that I shall make are strictly impersonal, are objective and are designed only to improve an activity of this Association which is more important to the profession than most of us realize.

The Library of the A.D.A. should perform well three functions: (a) to collect and preserve specific groups of literature; (b) to maintain a competent package library, and (c) to compile a comprehensive and accurate Dental Index.

I do not believe that any thoughtful member of the American Dental Association would urge that a large collection of books be uselessly stored in its Library; but all would agree that the Library should have complete collections of specific types of material: namely, the complete minutes, proceedings and transactions of the American Dental Association and all the official records of other dental organizations, present and past, that have contributed to the advancement of the dental profession in this country. In other words, it should be the official repository of historical records. It should maintain small, but adequate special collections or reference libraries for use by the departments, bureaus and commissions housed in the Central Office. It should preserve permanently in bound form all volumes

of all journals that are used for indexing purposes. This simple outline defines the least that might be expected of our Library. Currently, its achievements fall short of these stipulations.

The package library is most valuable to the scattered membership. Because of the growing dependence of the profession on its literature, the package library plan should be encouraged to the fullest. A package library, to be acceptable, must include all authoritative published contributions on a special subject, particularly research reports and articles of current or recent date. The maintenance from year to year of a large number of adequate package libraries is a stupendous task; but if a package library is not reasonably complete and up-to-date, it lacks usefulness. A library should endeavor zealously not to distribute incomplete collections. Accurate judgments cannot be formed from faulty evidence. The user of an incomplete collection may think that he has full information and, on that assumption, may publish conclusions drawn from partial evidence that are not only erroneous, but also injurious to later study. I have compared a number of the package libraries sent out from our Library with reasonably complete bibliographies on the same subject, and I regret to say that much remains to be done to bring our package libraries up to an acceptable standard.

THE DENTAL INDEX

The Dental Index is an indispensable tool in the ready and accurate service of a library. This Association has made an excellent contribution to the profession in supporting for many years the Dental Index. The dental school libraries have depended on it and have been so anxious to secure its benefits that each member library is now paying to the American Dental Association an indexing fee of $60 a year for the service. The student must depend on it and the investigator is completely lost without it. In view of its importance and because of the responsibility that the American Dental Association bears in the matter, only a product of the best quality should issue from our Library.

But those who have used the Dental Index and its service, especially the librarians, have long urged improvements in it. It is a matter of record that Arthur D. Black, its founder, was not entirely satisfied with its form or its service. In order to overcome the constant objections that had been registered, the Committee on Library and Indexing Service recommended a change in its form from the classified type to the alphabetical or dictionary type. The first volume in the new form has just been released. Its format is more pleasing than that of the earlier volumes, but a comparison of items in the new Index with the contents of journals used by the indexers shows many omissions, errors and discrepancies that are actual liabilities to the user.

As illustrations: The indexing of the journals is not thoroughly done; that is, many items pertaining to a subject are overlooked or ignored. In the circumstances, the list of items in any classification should be regarded by the user as a partial list. This statement can be verified by choosing journals on the list and comparing their subjects with the corresponding subjects in the Index.

While all of the better known journals are used for indexing, there are some lesser known but important ones that are disregarded. The arbitrary choice of some journals to the exclusion of others is difficult to understand. For instance: Among the fraternity publications, the *Alpha Omegan* is indexed, while the *Desmos,* the *Xi Psi Phi Quarterly* and the *Frater* are not. Among the colleges, the *Journal of the Baltimore College of Dental Surgery* is indexed, while the journals of the University of Indiana and the University of Mich-

igan are not. All these neglected journals, a list of at least twenty-eight, carry valuable contributions whose subjects should be included in the Index. There is no valid reason why any dental journal printed in English should be omitted by the Indexing Service.

Also, the Index should list all articles relating specifically to dentistry that are published in medical and scientific journals. A number of important articles on dental subjects appear from time to time in medical and other scientific journals, but they are lost to the user of the dental library because they are not listed in our Index.

My study of the manner in which the Library is meeting its responsibilities to the profession leads me reluctantly to the conclusion that its quality of service is not up to the needs of the profession, nor is it up to the standard of many other dental libraries or of the libraries of other professions. The Committee on Library and Indexing Service has made a careful study and faithful report on the Library conditions. I would recommend that this House of Delegates support the Committee on Library and Indexing Service in its efforts to correct the faults that I have pointed out. I do not recommend that any one be dismissed from his job. I do urge reform with whatever adjustments are imperative to achieve it.

ELECTION OF OFFICERS

Annually, the House of Delegates spends a good deal of time, much of it in confusion, in conducting its elections. The Constitution provides that "the election of officers shall be the first order of business of the House of Delegates after the reading of the minutes of the afternoon of the third day of the annual meeting of the House of Delegates." I recommend that the By-Laws be amended to provide for the nomination of all candidates for office as the last order of business on the afternoon of the second day of the annual meetings of the House of Delegates; that ballots be prepared containing the names of all nominees; that a ballot box be provided for purposes of balloting, and a suitable room be provided in which the voting may be conducted; that the polls be opened at 9 o'clock in the morning of the third day and closed at 2 p.m. on the same day, and that the report of the tellers be announced to the House of Delegates as the last order of business on the third day of the meeting. Such an arrangement would be much more simple than the present method of conducting elections and would remove from the final day's meeting much of the confusion about which many delegates have complained.

History shows that, from the time of the founding of the American Dental Association in 1859 to the present, any effort to alter its Constitutional and Administrative By-Laws or to change its Code of Ethics has met with determined opposition. I am, therefore, aware of the dangers involved in recommending changes in these established instruments. At the risk of reviving these usual contests, I shall call attention to the real need for improvement in our Code of Ethics. The first Code of Ethics was adopted by the American Dental Association in 1866. From that time until 1928, when the Code in its present form was approved, regular efforts were made to improve its quality. This Code was evolved over a long period when the profession found it necessary to combat constantly commercial influences in dental practice, and it was natural that the Association should have drafted what may be termed an anti-advertising Code of Ethics. It is written in a negative manner with little attention to positive aspects that should characterize the code of ethics of a learned profession. Recently, I made a careful study of the codes of ethics of a large number of professions including medicine, pharmacy,

nursing, architecture, accounting, journalism and teaching. All of these codes record a positive stand against unfair commercial tactics, but they also set forth the ethical obligation of men to meet their duties and responsibilities unselfishly and in the interest of the common good. There is a well-known book on professional codes of ethics that discusses the codes of a large number of professions, but makes no reference to the dental code. It would appear that the cause for this omission lies in dentistry's failure to include in its Code of Ethics definitions of professionalism and of professional relationships both within the profession and with the public. It would seem desirable in the interest of our self-esteem that the dental Code of Ethics be rewritten to include, in addition to the principles of anti-advertising, a positive statement of the ethical functions of the profession. I would, therefore, recommend that this House of Delegates approve the rewriting of the Code of Ethics and instruct the Judicial Council to bring in a report at the next Annual Meeting.

I shall conclude this report as I began it by thanking you for your cordial support and your courteous treatment during the year.

COMMITTEE ON LEGISLATION

ORGANIZATION AND FUNCTIONS OF THE PUBLIC HEALTH SERVICE

ON October 27, Congressman Bulwinkle of North Carolina returned S. B. 400 to the House from his subcommittee with a favorable report and the House passed the bill with some amendments. The part of this bill pertaining to dentistry that was incorporated in it in the Senate and passed by the Senate is not affected. This bill has now passed the Senate and the House and the Conference Committee and it is before the President for his signature.

Section III provides a dental division in the office of the Surgeon General. The officer while detailed in charge of such a division will have the temporary grade of Assistant Surgeon General and the rank of Brigadier General.

STERLING V. MEAD, *Chairman,*
Committee on Legislation.

DENTISTRY IN THE ARMED FORCES

THE Committee on Legislation wishes to thank all of the members of the American Dental Association who have so wholeheartedly supported legislative efforts to obtain improved conditions in so far as dentistry is concerned in the armed forces. Through your good efforts Congress has become well acquainted with the facts in the case and is in sympathy with our desire to make certain corrections.

As a result of this work and your splendid coperation, certain beneficial changes have already been made and others will no doubt follow.

We suggest holding the matter of legislative action in Congress in abeyance at the present time until a full opportunity is afforded for departmental changes. You may be sure that the Committee on Legislation will continue to urge these improvements.

In the very near future a report will appear in THE JOURNAL, which is now being prepared by your committee, covering all phases of this matter in an endeavor to allow all to fully understand the present status of this matter.

STERLING V. MEAD, *Chairman,*
Committee on Legislation.

WAGNER-MURRAY-DINGELL BILL, S. 1161

MEMBERS of the Committee on Legislation appeared before the House of Delegates and stated that they were anxious for definite and complete instructions regarding the Wagner-Murray-Dingell bill, S. 1161. We had been instructed by the President of the American Dental Association at a joint meeting considering this bill to make a report to you in conjunction with the Council on Dental Health and the Committee on Economics. Inasmuch as the responsibility for protecting the interests of the dental profession, if this or a similar bill is to be enacted, and since the Committee on Legislation feels that it is your opinion that this bill should be opposed; the Committee on Legislation does not want to be in the position of having to compromise with any other committee as to the manner of handling this matter.

The House of Delegates at the Cincinnati meeting of the American Dental Association adopted the following resolution:

"The House of Delegates of the American Dental Association, while endorsing the basic principles for the improvement of national health, must oppose the program of S. 1161 because of the eight principles which were adopted by this body in 1938.

"If legislative progress dictates a reconsideration of the dental aspects of S. 1161, the Board of Trustees is directed to take necessary steps, consistent with the actions of this House, or to convene the House of Delegates in special session in order to protect the interests of the public and of the profession."

The principles which have previously been approved by the House of Delegates of the American Dental Association and referred to in the recent resolution passed by the House of Delegates state that in the formulation of any National Health Program the American Dental Association should insist on the inclusion of the following principles:

"I. In all conferences that may lead to the formation of a plan relative to a national health program, there must be participation by authorized representatives of the American Dental Association.

II. The plan should give careful consideration to: first, the needs of the people; second, the obligation to the taxpayer; third, the service to be rendered; and fourth, the interests of the profession.

III. The plan should be flexible so as to be adaptable to local conditions.

IV. There must be complete exclusion of non-professional, profit-seeking agencies.

V. The dental phase of a national health program should be approached on a basis of prevention of dental diseases.

VI. The plan should provide for an extensive program of dental health education for the control of dental diseases.

VII. The plan should include provision for rendering the highest quality of dental service to those of the population whose economic status, in the opinion of their local authorities, will not permit them to provide such service for themselves, to the extent of prenatal care, the detection and correction of dental defects in children, and such other service as is necessary to health and the rehabilitation of both children and adults.

VIII. For the protection of the public, the plan shall provide that the dental profession shall assume responsibility for determining the quality and method of any service to be rendered."

The Committee on Legislation fully understands that the American Dental Association has recorded its opposition to compulsory health insurance and that it is opposed to the Wagner bill in its present form and all other legislation similar in character. Since the Committee on Legislation will have the responsibility for carrying out the wishes of the American Dental Association, it was felt that you should have entire confidence in the integrity of the committee to carry out these wishes in the best manner. Your Committee being bound by the recent instructions of the House of Delegates may be unnecessarily handicapped, especially if an emergency develops, and we will be expected to speak officially for the American Dental Association when time may not permit the calling in session of the House of Delegates. We will continually work in close harmony with the Board of Trustees, the President and other interested committees, as we have endeavored to do in all other legislative matters.

The action of the House of Delegates limits the Committee on Legislation activities to direct opposition of the Bill under all circumstances regardless of what changes may be imminent. The committee further interprets the resolution to mean that the Board of Trustees' actions are also limited by the same controls and that "if legislative progress dictates a reconsideration of the dental aspects of S. 1161" the Trustees are authorized to convene the House of Delegates in special session for further instructions. In Cincinnati your committee contended that this is rather slow procedure to meet emergency situations should they arise.

Perhaps our concern over the matter is unnecessary since in our opinion the Bill will not be called up until next year and then it will have a long road to travel before it reaches Congress for action where under present conditions it will probably receive unfavorable consideration. There are two factors which will tend to defeat this bill; one is the staggering cost and the great addition to over-burdening taxes at this time. Another factor is that there is a tendency in Congress to realize the importance of State rights, and the danger of centralization of power in the central Government.

For many years leaders in the dental profession have contended that the health professions should assist in developing plans for a more adequate distribution of dental health service and, if this was not done, others would take the initiative and promote a far more unfavorable program than would be the case in the event that it was planned through the cooperation of all of the interested parties. Some persons assume that all of this is the result of the so-called New Deal, but this is controversial.

The committee on the cost of medical care was created during the heyday of prosperity and also this same subject was discussed at the White House conferences, commencing back in 1929. It does not seem advisable to take a strictly negative attitude toward social changes, but it would seem advisable to attempt a policy of cooperation and to assist in modifying some of the more radical proposals.

Your Committee on Legislation is on record as continually suggesting the advisability of the early completion of a health program by the American Dental Association. It is possible that, unless this is done, your committee and your Association may be somewhat handicapped in the future, when this or other legislation of its kind is being considered.

Many of the state societies have already sent in resolutions to Congress and to the Committee on Legislation and

many of these resolutions differ. Some are unalterably opposed to all forms of legislation and others are opposed to this legislation in its present form. It would appear advisable to the Committee on Legislation that each state society prepare a resolution based upon the resolution passed by the House of Delegates and send it to the Committee on Legislation so that we may present it at the proper time. Timing is very important in matters of legislation, and if these resolutions are sent in from time to time, they will be filed and forgotten at the time the matters are under immediate consideration.

Your committee feels that you desire an active rather than a passive attitude with regard to this bill. We will keep in close touch with all of the states and see all the members of Congress and endeavor in every way possible to defeat this bill. We shall work with the committees of the American Medical Association and we shall suggest certain publicity in this matter at the opportune time. If this is not your understanding in the matter you should contact the Committee on Legislation and give us the benefit of your ideas.

We must not minimize the importance of the proposals which will soon be considered by Congress with regard to social legislation, and we must realize that the powerful group supporting these ideas are not underrating the opposition of the medical profession and dental profession.

STERLING V. MEAD, *Chairman,*
Committee on Legislation.

BUREAU OF PUBLIC RELATIONS

AKRON, OHIO, COUNCIL ON DENTAL HEALTH

IN 1941 the Lay Education Committee of the Akron, Ohio Dental Society, in cooperation with the Akron Board of Education and the city and county health departments and the Parent Teacher Association, developed a definite dental health educational program for the Akron public schools.

The Dental Society sponsored a two weeks puppet show, furnished dental health column material for the newspapers and educational material for each monthly issue of the Akron Parent Teacher Association Bulletin.

Furthermore, the Society agreed to sponsor a Child Dental Health Week Program and accept membership on the Speakers Bureau of the Public School Radio and Physical Welfare Committee.

Thus, the Akron Dental Society laid the ground work for a more pretentious dental educational program and prepared its members and the laity for participation in the Council on Dental Health program recommended by the American Dental Association in February, 1943.

The Akron, Ohio Dental Society was one of the first local dental societies to cooperate in the establishment of local Councils on Dental Health and in the endorsement of the High School Victory Corps Physical Fitness Dental Program. By early spring the Akron High School Victory Corps Dental Program was well organized and the cooperation of all leading health, educational and welfare organizations was assured.

During the summer months definite plans were made for the examination of all of Akron's 17-year-old youths during the second week of the fall school term.

The City Health Department will follow up each case to see that all necessary dental attention is completed.

DENTAL CARIES AT BOYSTOWN

J. R. THOMPSON,* D.D.S., M.S.P.H., Lincoln, Nebr.

IN May 1942, a year's study was begun at Boystown, Nebr., with three objectives: to determine (1) whether it is possible to reduce the incidence of dental caries in a particular age group (12 to 17 years) in an institution by the reduction of free sugar in the diet and, at the same time, provide a diet that will maintain normal health, growth and development; (2) the yearly increment of dental caries in the same age group, and (3) the extent of a corrective program necessary to meet the dental health needs of the entire group of boys in residence at Boystown.

This study was made by the director of the division of dental hygiene, Nebraska State Department of Health, in response to a request from the dentist in charge of the dental infirmary at Boystown because of his interest in the prevention of dental caries. In a conference with the director of the institution, the objectives of the program were presented and the facilities, equipment and cooperation needed to carry it to completion were assured.

The Right Rev. Msgr. Flanagan is the founder and director of Boystown, an institution located 10 miles west of Omaha, Nebr., which was founded in 1917 as a home for homeless boys of any race, color or creed and has grown until it accommodates at the present time about 350 boys and comprises 760 acres of land and twenty-one buildings. These buildings provide space for living quarters, schools, shops, administration, an infirmary with medical and dental facilities, a postoffice and a church.

The dental department consists of two completely equipped operating rooms and a reception room in the infirmary, where two nurses are in constant attendance and a physician is subject to call. Dr. Hugh McDonnell, assistant professor and instructor at Creighton University, College of Dentistry, who is in charge, assisted by a junior or senior dental student, devotes one-half day a week to the dental care of the boys. The type of dental service rendered consists of amalgam and silicate cement fillings, extractions, prophylaxis and an occasional restoration of lost teeth. The service is of high quality.

The enrollment is of necessity changing constantly, owing to graduation, enlistment in the armed forces, arrival of the draft age or other conditions. For this study, therefore, those boys were eliminated who would reach the age of 18 during the ensuing year.

Two specimens of saliva, collected twenty-four hours apart from 260 boys, were taken the first thing in the morning, before teeth were brushed or breakfast eaten. The lactobacillus counts were determined in the Public Health Laboratory of the Nebraska State Department of Health. Of the group, 120 boys with the highest bacterial counts (ranging from 3,000 to 700,000 per cubic centimeter of saliva) were chosen for the study.

Each of the boys selected received two dental examinations, made by different dentists using mouth mirrors and explorers, so that a double check was

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obtained. All fillings, cavities and missing teeth were recorded on examination blanks. The approximate size and location of fillings and cavities were outlined. The time spent in each examination was from six to eight minutes. Bitewing roentgenograms of the posterior teeth were taken, to detect beginning interproximal caries, and these areas were charted. Bite-wing roentgenograms disclosed 369 interproximal carious areas that had been overlooked in the two oral examinations of the 120 boys; or an average of 3.1 per boy.

The boys selected for the study were divided into two groups of sixty each, to be known as the diet and the control group. This selection was made after the program was explained and the boys had been asked to volunteer to eat at a table for a limited period of time at which no sugar would be served. They were promised that if the bacterial counts were materially reduced, simple desserts would be added to their menu.

It should be noted that the sixty boys who volunteered for the diet group were those who had on the average higher initial bacterial counts than the boys in the control group, as the diagram will show. The fact that the more highly susceptible in the group volunteered to participate in the experiment is very characteristic of "volunteer" sampling.[1] However, the sampling technic did not appear to operate at a disadvantage in this study, as will be seen later. No change was to be made in the regular diet of the control group.

Single specimens of saliva were taken every thirty days from the boys in both groups and records kept of the successive bacterial counts. The average bacterial count per cubic centimeter of saliva of the two initial specimens of saliva in the diet group was 33,800. At the end of the first month, the average bacterial count had dropped to 4,900, and it continued to drop each month until August (third month), when it was 1,850. In September, a slight increase was noted, despite the fact that saliva specimens from twenty-six boys were negative. In October, the average count arose still higher. At this point, a visit was made to Boystown to investigate the cause of the rise in the average bacterial count.

It was learned that, in Sepember, a canteen had been instituted on the grounds where candy bars, ice cream, soda pop, apples, oranges and other sundries were easily available—articles which it had not been possible to secure there before this time. In a discussion with the management regarding the effect of this innovation on the diet of the boys and the control of dental caries in the diet group, the fear was expressed that the efforts to reduce dental caries would be nullified. The management decided to continue the operation of the canteen, since discontinuance would be difficult and, owing to the sugar-rationing program, the supply of sweets might

TABLE 1.—DIET GROUP OF THIRTY-FIVE BOYS: NUMBER OF FILLINGS, CAVITIES, MISSING TEETH AND TOOTH SURFACES INVOLVED

Year	Fillings	Cavities	Missing Teeth	Tooth Surfaces Involved	Average Number Tooth Surfaces Affected per Boy
1943	171	372	31	748	21.4
1942	111	384	27	640	18.3

be limited and the ill-effects perhaps minimized.

The monthly examination of saliva specimens was continued for the year as planned and a continuous rise in the bacterial count was noted, until January, when it reached 80,500 in the diet group. It remained high from that time until the end of the study, in May 1943. The diagram shows the same general pattern for the bacterial counts of the control group.

Thus, after four months of effective control of the bacterial counts of the saliva of the boys in the diet group, it was considered no longer possible to attain the first objective of the study (the reduction of caries) because of the ready accessibility of sweets.

Table 2.—Control Group of Thirty-Two Boys: Number of Fillings, Cavities, Missing Teeth and Tooth Surfaces Involved

Year	Fillings	Cavities	Missing Teeth	Tooth Surfaces Involved	Average Number Tooth Surfaces Affected per Boy
1943	106	262	14	439	13.8
1942	59	263	13	374	11.7

YEARLY INCREMENTS OF DENTAL CARIES

The same type of dental examination was made at the end of the year's study as was used at its beginning. Fillings, cavities and missing teeth were again recorded. Again, bitewing roentgenograms were taken. Thirty-five boys remained in the diet group at the end of the year and thirty-two remained in the control group, or approximately 20 per cent of the entire enrollment. Each of these boys had submitted specimens of saliva regularly every thirty days and each was present for the final examination.

In the diet group, sixty fillings were placed during the year in the 384 cavities present when the initial examination was made in 1942, 324 unfilled cavities from the original 384 remaining. Subtracting 324 from 372, which was the number of cavities found in the examination made in 1943, leaves forty-eight as the number of new cavities that developed during the year; an average of 1.5 cavities per boy.

In the control group, forty-seven fillings were placed during the year in the 263 cavities present when the initial examination was made in 1942, 216 unfilled cavities from the original 262 remaining. Subtracting the 216 cavities from the 262 found in the examination in 1943 leaves forty-six new cavities developed during the year, an average of 1.3 cavities per boy.

In the group of sixty-seven boys completing the study (diet group and control group), there were 107 fillings placed during the year. In the same year, ninety-four new cavities developed.

These sixty-seven boys represent approximately one-fifth of the population of Boystown. If the same proportion of service were rendered and the same average caries rate prevailed for the remainder of the population in the year 1942-1943, there would be five times as many fillings made, or 535, and five times as many new cavities would have developed, or 470.

DISCUSSION

While the introduction of readily available sweets and concentrated carbohydrates interfered with the first objective, dental caries control, certain pre-

dictions can be made. It is generally accepted by research workers that the number of *L. acidophilus* in the saliva is an accurate index to the caries activity. Arnold and McClure[2] state:

The dental caries experience rate and the increase in that rate over a period of one year has been determined on 217 white school children, living in Arlington, Virginia. The study group was classified according to the degree of caries activity during the year. Bacteriological studies of the saliva were made on individuals belonging to the various clinical types. A close relation was found to exist between dental caries activity measured by repeated clinical examination, and the number of *L. acidophilus* in the saliva.

Kesel,[3] writing on dental caries, makes the following comment:

A total of 816 lactobacillus tests were made on fifty students. The results in thirty-four, or 68 per cent, of the individuals were in complete agreement; that is, both the averaged tests and the degree of clinical activity were the same. In six, or 12 per cent, the degree of activity of the test indicated that more caries should have developed than actually occurred; whereas, in five, or 10 per cent, the test indicated less activity than developed. In all of these cases, that is in 90 per cent, the test correctly indicated the trend of caries activity. In only five cases, or 10 per cent, did the results of the test differ from the clinical developments.

After a discussion of the technic of growing lactobacilli, Philip Jay[4] says:

By this method it is possible to estimate the relative numbers of lactobacilli per unit of saliva and in the great majority of cases a relationship has been observed not only between the occurrence of these organisms and the incidence of caries but also between the degree of caries activity and the abundance of the organism as well. Since the saliva becomes infected with these organisms several months before the disease is clinically demonstrable, it is possible by bacteriologic methods to predict the onset of caries activity with surprising accuracy.

L. S. Fosdick[5] says:

It has been shown that the Bacillus acidophilus count is materially higher in caries active mouths than in caries immune mouths, providing a suitable medium of this determination is used. This difference is sufficiently accurate to be of material benefit as a diagnostic procedure.

In *L. acidophilus* studies of three distinct groups of 122 students each, Collins, Jensen and Becks[6] state that "the findings under Paragraph 1 show a striking correlation between the presence and absence of *L. acidophilus* in saliva with caries activity and with freedom from caries respectively." Similar observations have been made by Becks, Foor and Shulman.[7]

In the light of the results of previous research and the conclusions drawn, it can be predicted that, with the increase of the bacteria which has developed with the increased intake of concentrated carbohydrate at Boystown, there will be an increase of dental caries.

Dental examinations at the beginning and end of the study revealed that the average increment of dental caries is 1.4 cavities per boy. The present dental corrective facilities are adequate to care for an average of 1.6 cavities per boy, indicating that the services now being rendered are adequate to care for only slightly more than the increment of caries developing at the present time.

Dental examinations made in 1942 revealed that 647 cavities were present in the teeth of the sixty-seven boys, or an average of 9.6. The examination made one year later revealed that there were still 634 cavities in spite of fillings and extractions, or an average of 9.4 cavities. These numbers represent an accumulation of defects that the present dental facilities are unable to eradicate. The present dental corrective program will care for the yearly increment of dental caries plus only 0.2 cavity per boy of the accumulated dental defects.

CONCLUSIONS

1. There will probably be an increase

in caries activity at Boystown, induced by the ready availability of sweets and concentrated carbohydrate.

2. The average yearly increment of dental caries in the age group (12 to 17 years) is 1.4 cavities per boy.

3. The dental facilities available (one-half day per week for two dentists) are adequate to care for slightly more than the increment of dental caries, or 1.6 cavities per boy. Under the present program, the accumulated defects cannot be eliminated.

BIBLIOGRAPHY

1. HILL, BRADFORD: Principles of Medical Statistics. London: Lancet Ltd., 1937, pp. 14-16.

2. ARNOLD, F. A., and MCCLURE, F. J.: Study of Relationship of Oral Lactobacillus Acidophilus and Saliva Chemistry to Dental Caries. *Pub. Health Rep.*, 56:1495-1514, July 25, 1941.

3. KESEL, R. G.: Dental caries: Etiology, Control and Activity Tests. J.A.D.A., 30: 25-39, January 1943.

4. JAY, PHILIP: Bacteriologic and Immunologic Changes in Dental Caries, in Gordon, S. M.: Dental Science and Dental Art. Philadelphia: Lea & Febiger, 1938, pp. 348-372.

5. FOSDICK, L. S.: Correlation of Some Facts Concerning Aetiology and Control of Dental Caries. *Canad. D. A. J.*, 9:359-366, August 1943.

6. COLLINS, R. O.; JENSEN, A. L., and BECKS, HERMANN: Studies of Caries-Free Individuals: II. Is Optimum Diet or Reduced Carbohydrate Intake Required to Arrest Dental Caries? J.A.D.A., 29:1169-1178, July 1942.

7. BECKS, HERMANN; FOOR, GLEN, and SHULMAN, I. M.: Importance of Lactobacillus Acidophilus Index Determinations in Orthodontic Practice. *J. D. Res.*, 22:215-216, June 1943.

INDIANA STATE COUNCIL ON DENTAL HEALTH

THE Council on Dental Health of the Indiana State Dental Association, cooperating with the State Superintendent of Public Instruction and State Board of Health, recently inaugurated a very practical plan designed to promote the High School Victory Corps Physical Fitness Dental Program in that state.

The State Superintendent of Public Instruction arranged six regional meetings of school officials to discuss educational policies, including the high school dental policy. These six meetings were scheduled for the week of October 4th. Since dentistry is considered an essential part of the high school educational program in Indiana, the Council on Dental Health was asked to supply a speaker before each of the six meetings. Dr. Drexell A. Boyd, Secretary of the State Council on Dental Health and Dr. David N. Stiefler of the State Board of Health, represented dentistry on the programs. The other speakers were Dr. Clement T. Malan, State Superintendent of Public Instruction; Mr. Wilbur Young, Chief Inspector of Indiana High Schools; Dr. Robert E. Jewett, Acting Chief, Bureau of Maternal and Child Health, Indiana State Board of Health, Mr. Frank S. Stafford, state director of physical fitness.

All the meetings were scheduled to be in session at the High School Building in one of the principal cities in each of the six regions from 10 a.m. until 3 p.m. These meetings were held in Newcastle, Columbia City, Valparaiso, Crawfordsville, Washington and Madison, Indiana.

Members of the Indiana Council on Dental Health received a copy of a letter from Dr. E. E. Ewbank, Secretary of the Indiana State Dental Society, requesting that they attend one of these regional meetings in order that they might thoroughly familiarize themselves with the objectives of the program.

This program has proved very effective in publicizing and motivating the High School Victory Corps Dental Project in Indiana and other state councils may wish to develop a similar project.

DENTAL PICTORIAL

PROGRESS REPORT

IT has been a little over a year since the Board of Trustees approved the Public Relations Committee's recommendation to launch "Dental Pictorial," a bi-monthly dental magazine for the laity, selling at $1.00 for 12 issues.

"Dental Pictorial" was first announced to the profession last February at the Chicago Midwinter meeting. At that time the Public Relations Committee optimistically believed that, with a membership of 58,000, the American Dental Association could easily and quickly obtain 100,000 subscriptions for the magazine—a minimum of 100,000 subscriptions being necessary to make "Dental Pictorial" self-supporting.

The Public Relations Committee has no sales force. However, many of the dental dealers offered their manpower to help build circulation among our members. With a potential sales force of approximately 500 dental salesmen at their disposal, the Public Relations Committee anticipated that "Dental Pictorial's" circulation problem would be no problem at all.

However, there is many a slip between the cup and the lip. In spite of the fine work done by many of the dental salesmen and in spite of the announcements published in THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION and state and component journals, "Dental Pictorial" circulation is far short of its 100,000 goal. Some new method or methods must be devised to interest our members to buy blocks of at least 5 or 10 subscriptions each.

The Public Relations Committee and the Council on Dental Health are firmly convinced that there is a need for "Dental Pictorial." Letters from educators, public health workers, dentists and dealers substantiate that belief. Therefore, the Public Relations Committee is, at the present time, considering a circulaion plan based on local dental society participation. If adopted, this plan will permit members of a society to pool their subscriptions. Copies of the magazine would then be mailed in the name of the society to educators, health workers, etc., in the community.

The Public Relations Committee makes this report at this time in order to keep our members informed of the Dental Pictorial project.

The committee takes this opportunity to thank the Association members and friends who have subscribed to date and requests their patience until we are able to build circulation to a point that will warrant going to press.

Address your inquiries and orders to the Bureau of Public Relations, American Dental Association, 222 E. Superior St., Chicago, Illinois.

DENTAL HEALTH SECTION AUTHORIZED FOR THE AMERICAN PUBLIC HEALTH ASSOCIATION

By action of the governing Council of the American Public Health Association, the Oral Health Group was given the status of a dental section at the American Public Health Association's 72nd annual meeting, Pennsylvania Hotel, New York City, October 13.

The officers for the new Dental Health Section for the coming year are:

Chairman: Kenneth A. Easlick, M.S., D.D.S., School of Public Health, University of Michigan, Ann Arbor, Michigan.

Vice Chairman: J. M. Wisan, D.D.S., State Department of Health, Trenton, N. J.

Secretary: W. J. Pelton, B.S., D.D.S., M.S.P.H., U. S. Public Health Service, Washington, 14, D. C.

Section Council:

5 years—C. R. Taylor, D.D.S., M.S.P.H., Michigan State Health Department, Lansing, Michigan.

4 years—Lester A. Gerlach, D.D.S., City Health Department, Milwaukee, Wisconsin.

3 years—George A. Nevitt, D.D.S., M.S.P.H., Sub-Treasury Bldg., 15 Pine Street, New York, N. Y.

2 years—Richard C. Leonard, D.D.S., M.S.P.H., State Department of Health, Baltimore, Maryland.

1 year—Allen O. Gruebbel, D.D.S., M.P.H., State Board of Health, Jefferson City, Mo.

The Oral Health Group, under the chairmanship of C. R. Taylor, Michigan State Health Department, Lansing, Michigan, held a very successful meeting on Thursday, October 14.

The program for the morning session was devoted to:

"Post-War Implications of Fluorine and Dental Health."

From the viewpoint of an epidemiologist—H. Trendley Dean.

From the viewpoint of a water works engineer—Raymond J. Faust.

From the viewpoint of operative dentistry—John W. Knutson.

From the viewpoint of public health dentistry—A. O. Gruebbel.

The Friday afternoon session was devoted to a joint program with the School Health Section of the A.P.H.A. and the American School Health Association. The program was as follows:

"Implications of the Victory Corps Program."

From the dental viewpoint—J. A. Salzmann and Leon R. Kramer.

From the health officer's viewpoint—Carl A. Wilzbach, M.D.

From the educator's viewpoint—John Lund.

Report of the Conclusions of the Workshop Session on Adjustments of School Health Personnel in Wartime.

Other dental speakers appearing on the program of the A.P.H.A. were: John Oppie McCall (who represented the dental profession in the Workshop on Adjustments of School Health Personnel in Wartime); J. L. T. Appleton, who presented a paper on "The Relation of Oral to Respiratory Infections" before the Laboratory Section, and George A. Nevitt, who presented a paper on "Post-war Dental Programs for Official Health Agencies" before the Health Officers Section. C. R. Taylor presented a paper entitled "Preventive Industrial Dentistry" before the meeting of the Industrial Hygiene and Health Officers Sections. Francis Krasnow, Ph.D., of the Murry and Leonie Guggenheim Dental Clinic, presented a paper on "Dental Caries Control in School Children" at the meeting of the A.S.H.A.

COUNCIL ON DENTAL THERAPEUTICS

GLUCAINE—NOT ACCEPTABLE FOR A.D.R.

A COPY of the following report, which has been adopted by the Council, was sent to the firm before publication. The reply of the firm did not include any scientific data which would justify modification of the original report.

DONALD A. WALLACE, *Secretary.*

Glucaine (Lee S. Smith & Son Mfg. Co., Pittsburgh, Pa.), which is defined on the package label as "procaine gluconate solution with epinephrine" has been promoted to the dental profession in full-page ads in a widely distributed dental journal during recent months.

Claims for lack of toxicity, gentleness, speedier onset of anesthesia, deeper anesthesia and lessened postoperative complications are advanced for the product. On March 1, 1943, a request for references to scientific data upon which the claims made for Glucaine are based was sent to the firm. The following paragraph is quoted from the firm's reply, which was received March 19:

> I am preparing such information as we have available in response to your inquiry and will send this on to you at the earliest possible opportunity. However, you can appreciate that it will take a few days to get this data together and I will ask for your forebearance in the additional delay necessary.

The letter was signed by the president of the firm. No further communication has been received from the firm. Therefore it is necessary to base an evaluation of the product on information which is available.

The advertising states: ". . . Glucaine's greater 'CQ' (Compatibility Quotient) is the result of using a mild organic acid to replace harsh hydrochloric acid to form the water soluble salt for carrying procaine into tissue." "Glucaine . . . gives you the full potency of procaine *without hydrochloric acid. . . .*"

Apparently the claims for superiority of Glucaine Solution over the widely used procaine hydrochloride solutions are based on

1. The assumption that hydrochloric acid is present in clinically significant amount in procaine hydrochloride solutions.

2. The assumption that there is less free acid in Glucaine as it is marketed to the dentist.

A package of 100 cartridges was purchased on the open market. It bore the following label statement:

Each cc. Contains	
Procaine Gluconate (as base)	0.02 gm.
Gluconate Radical	0.019 gm.
Synthetic Epinephrine Bitartrate (as base)	0.00003 gm.
Chlorbutanol	0.005 gm.
Sodium Chloride	0.0066 gm.
Sodium Thiosulphate Anhydrous	0.001 gm.
Sodium Bisulphite (less than)	0.00067 gm.
In distilled water	

Lee Smith GLUCAINE*
PROCAINE GLUCONATE SOLUTION
WITH EPINEPHRINE
Lee S. Smith & Son Mfg. Co.
Pittsburgh, Pa., U.S.A.
*Reg. U. S. Pat. Off.

The product was submitted to examination by the A.D.A. Bureau of Chemistry. The findings of the Bureau are summarized as follows:

pH	5.0
Titratable Acidity (cc. of .1 N NaOH required to bring 10 cc. of Glucaine to a pH of 7.4)	2.35 cc.
Procaine in terms of base	2.09 gm./100 cc.

An appreciable number of undissolved

particles, visible to the unaided eye, were seen in the product.

The pH value and the value for titratable acidity are the same as would be characteristic of an ordinary commercial 2% solution of procaine hydrochloride. In other words, Glucaine apparently contains just as much and as strong acid as many commercial solutions of procaine hydrochloride.

In its efforts to sell Glucaine to the dentist, the firm has played upon the fallacious notion that there is a clinically significant quantity of free hydrochloric acid in properly prepared solutions of procaine hydrochloride. Its own product is without demonstrated advantages.

The firm's right to an exclusive proprietary name for the product has not been shown.

Glucaine is marketed in violation of Council rules 6, 8 and 10, and is therefore declared not acceptable for A.D.R.

FEDERAL TRADE COMMISSION COMPLAINT ON FORHAN'S TOOTHPASTE

ZONITE Products Corp., Chrysler Bldg., New York, engaged in the sale of Forhan's Toothpaste, a cosmetic preparation, and Erwin, Wasey & Company, Inc., 420 Lexington Ave., New York, advertising agency, which has participated in the preparation and dissemination of advertising matter for Forhan's Toothpaste, are charged in a complaint issued by the Federal Trade Commission with misrepresentation.

In advertisements in newspapers and periodicals, by radio continuities and other means, the respondents, the complaint alleges, have represented, among other things:

"Examine your gums closely. Are they tender, sore to the touch? Do they bleed when you brush your teeth? Then any one of these signs may mean that Gingivitis has started its silent work on you. This mild gum inflammation is so common today that four out of five may have it. If care isn't taken—it may lead to Pyorrhea, which only your dentist can help. See your dentist—then at home help guard against Gingivitis with Forhan's Toothpaste and massage. This time tested Forhan method not only helps gums to be firmer—but also brightens dingy teeth to their natural sparkling lustre. Forhan's costs no more than ordinary toothpastes—so why not enjoy its advantages."

"If neglected—Gingivitis may lead to dreaded Pyorrhea, to shrinking gums and loosened teeth which often have to be extracted in the last stages of Pyorrhea."

"Forhan's with massage not only helps gums to be firmer, but actually cleans dull teeth to their own *natural white brilliance.*"

"No wonder so many dentists for over twenty years have used and recommended Forhan's."

Through these and other statements and claims, the complaint alleges, the respondents have represented that the product, when used on the gums, will make the gums firmer, protect the user against gingivitis and pyorrhea, and is of value in the treatment of gingivitis; that it will cause the user's teeth to become naturally white, sparkling, bright and lustrous and protect them against decay by removing acids and acid films; that large numbers of dentists have for years recommended it for these purposes; and that, by comparison with Forhan's, all other toothpastes are "ordinary" and inferior.

The complaint alleges that:

The foregoing statements and representations are false and misleading. In

truth and in fact, Forhan's Toothpaste however applied, will not afford any protection to the user against either gingivitis or pyorrhea and is of no value in the treatment of gingivitis or any other ailment or condition of the mouth or gums. The firmness of gums is primarily dependent upon the general condition of the system and supporting mechanism of the teeth, and will not be enhanced, improved or affected by the use of said product either as a dentifrice, as a rubbing medium or both; the user will not be protected against gingivitis or other gum troubles nor rendered less susceptible thereto. Any benefit that may result from rubbing said product on the gums is due solely to the rubbing and not to any property of the toothpaste. Whether teeth naturally possess "whiteness," "sparkle," "brightness" and "lustre" depends upon the natural qualities of the tooth enamel. The teeth of some people possess these qualities; those of others do not and in such cases none of these qualities will be attained, acquired or disclosed through the use of Forhan's Toothpaste whether it is rubbed on the gums, used as a dentifrice or both. Forhan's will not, however used, protect the teeth of the user against decay. There is no substantial body of medical or dental opinion which holds that Forhan's dentifrice, when used as directed, will protect the teeth against acids or acid films in the localities where decay is most prevalent. The only value of Forhan's toothpaste is as a not unpleasant adjunct to the use of the toothbrush in cleaning the teeth. No substantial number of dentists has recommended Forhan's as a means of accomplishing the results claimed by the respondent. The respondent's toothpaste possesses no inherent superiority in any respect over other toothpastes which warrants the characterization of such toothpastes by respondent as ordinary or common by comparison with the respondents' product. Forhan's is in no respect extraordinary.

The acts and practices of the respondents, the complaint alleges, are all to the prejudice and injury of the public and constitute unfair and deceptive acts and practices within the intent and meaning of the Federal Trade Commission Act.

Complaint 5031, August 23, 1943.

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies.

Anesthetics—Local—Slightly Soluble*

Benzocaine-Benzyl Alcohol Solution: Each 100 cc. is stated to contain benzocaine, 20 gm.; erythrosine, 0.14 gm.; and benzyl alcohol, q.s.

Manufactured by Hammer Laboratories, Chicago, Illinois.

Admission of a product to the list of Accepted Dental Remedies does not imply a recommendation. It means that the product and the methods by which it was marketed at the time of consideration were not found to be in violation of the Council's published rules. Accepted products are reconsidered periodically. The files of the Council contain information on many drugs and dental cosmetics. All information is available upon request and inquiries are welcomed. A postal card will bring a prompt reply.

DONALD A. WALLACE, *Secretary.*

*A.D.R. Ed. 9, p. 58.

INSURANCE COMMITTEE

REPORT TO THE HOUSE OF DELEGATES OF THE AMERICAN DENTAL ASSOCIATION

THIS report marks the beginning of the tenth year that the American Dental Association Group Insurance has been with The Great-West Life Assurance Company. The policy has increased more than 33⅓ per cent during that time and is expected to reach $25,000,000.00 by July 1, 1944.

Since the inception of the American Dental Association Group Insurance Plan, the amount paid beneficiaries has aggregated $2,673,000.00. This is as of July 1, 1943.

New insurance issued during the year July 1, 1942 to June 30, 1943 has been very satisfactory. As far as we have been able to ascertain, the effect of the war has been of such small consequence as to be of no importance. Although a war clause is included in all new policies issued since April 15, 1942, many new certificates are being issued to members serving in the Armed Forces. This is due to the fact that our war clause is much more liberal than individual policies contain. Since all premiums are refunded to the beneficiary with 3 per cent interest thereon in event the war clause becomes operative, the insurance is attractive to the member as an investment if for no other reason. If the clause does not become operative, the full amount of the insurance is of course payable in event of death. In addition to the above, the member who takes out the American Dental Association Group Insurance now will have the insurance after the war is over even though he may not be insurable at that time.

A new conversion privilege has been added for the benefit of present and future policyholders. The old plan provided the right of conversion, without evidence of insurability, at age 51. The new privilege allows the right of conversion to all policyholders after they have been in the group five or more years, irrespective of age or physical condition. Conversion, as you know, means the exchange of the group insurance for an individual policy on the ordinary life, limited payment life or endowment plan at prevailing rates for standard risks. We feel that this new conversion right increases the flexibility of our group plan to the extent of meeting every individual requirement that may be brought about by changes in the financial circumstances of the member insured.

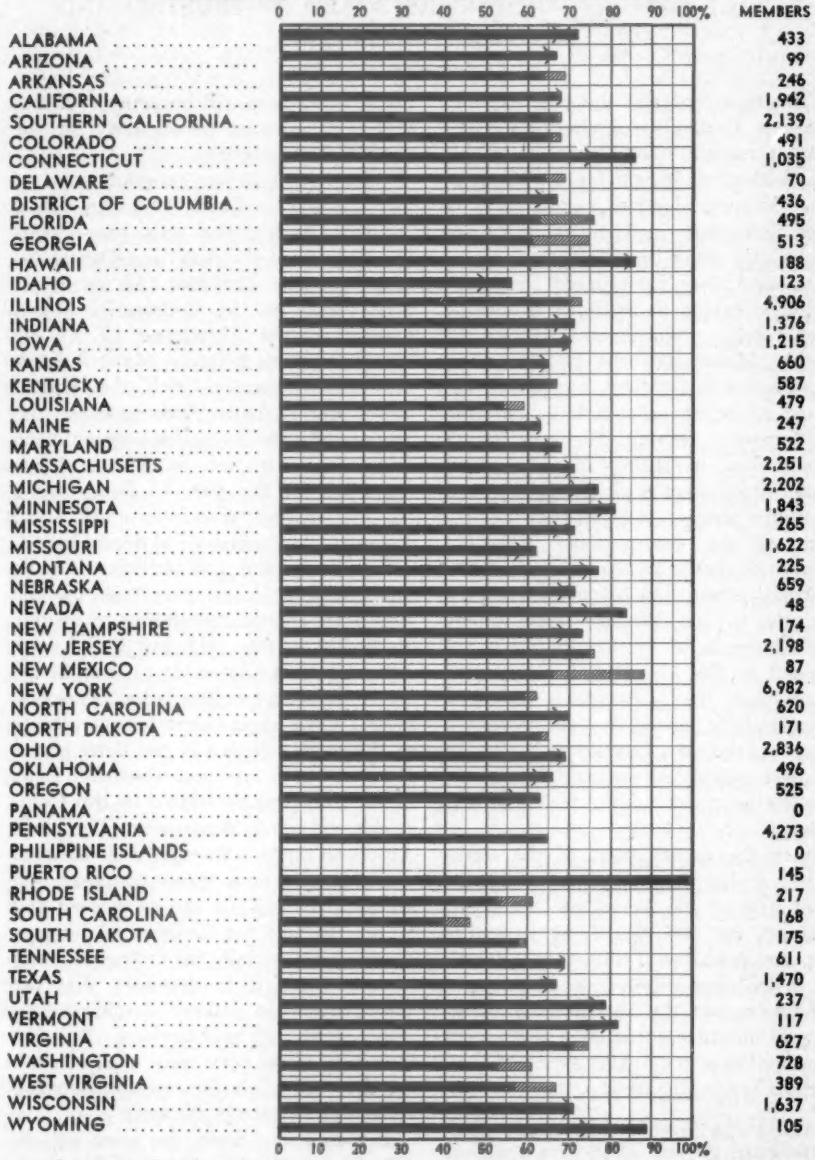
The subject of lapses is most interesting to the Committee because it is indicative of our insurance plan's success or failure. In spite of the fact that the group is larger now than ever before, our lapses are less than 1 per cent as compared with 4 to 4½ per cent experienced by Ordinary Life companies. This is interpreted by us as an expression of confidence and satisfaction in the plan.

Respectfully submitted,

A. D. WEAKLEY, *Chairman,*
FRED A. RICHMOND, *Secretary.*

Membership Page

PERCENTAGE OF DUES RECEIVED IN CENTRAL OFFICE AS OF OCTOBER 31, 1943, AS COMPARED TO 1942 MEMBERSHIP



Percentage based on dental population figures supplied by the State Society Secretaries.

1943 percentage 1942 percentage

INTERNATIONAL RELATIONS COMMITTEE*

REPORT FOR 1943 TO OFFICERS, BOARD OF TRUSTEES AND HOUSE OF DELEGATES

THE third report of the International Relations Committee is important because it records steady progress in this new field of endeavor for the Association. Visiting dentists from countries other than those in Latin America are enthusiastic about the work of the Committee and they have urged the Association to extend its activities to include other foreign countries throughout the World. Many take the position that, since American Dentistry is generally accepted as being pre-eminent, therefore the American Dental Association has a responsibility in seeing that American dental information is widely disseminated to other countries. It is felt that the program of the International Relations Committee should be made international in scope rather than being confined exclusively to the Western Hemisphere. The Chairman of the Committee is not opposed to this idea, but he is anxious to complete the work which has been so successfully started in Latin America. If we succeed on a permanent basis with our near neighbors, we may then go on to other countries with a feeling of experience.

Since the organization of the Committee, it has functioned as a Special Committee of the American Dental Association, but it is gratifying to realize that the Board of Trustees last February in Chicago approved of the recommendation that the International Relations Committee be made a permanent standing Committee. It is expected that, at the Cincinnati meeting, this constitutional procedure will be completed and that it will insure permanency for the work of the Committee.

With regard to our program, most of the initiative in Latin American dental relations during the past three years has come from the American Dental Association. The President and the Secretay-General of the Federación Odontológica Latino Americano (F.O.L.A.) have been most helpful. Many individual practitioners in both the United States and in Latin America have also cooperated. However, there has not been originality, initiative or organized cooperation on the part of most of the national dental associations of Latin America. The exchange of dental knowledge, information and activities must be reciprocal. It is all very well for the American Dental Association to assume leadership in this field, but if the work is to endure, it is necessary that all of the Latin American national dental associations assume their rightful responsibility in the work. If this is not done on an organized plan, within a reasonable time, the various projects started by this Committee will not be permanent. The Latin American dentists through their national dental associations must cooperate on an equal basis if we are to succeed and go on. In fact, for the good of our program, and especially for the permanency of the work, it is necessary that the Latin American national dental associations form "Pan-American Relation Committees" or plan some type of project that will allow for equal responsibility and enjoyment in the work.

If this is not done, the work will be one-sided and will tend to bring criticism and misunderstanding upon us.

*At the Cincinnati meeting of the House of Delegates, the title of the Pan American Relations Committee was changed to International Relations Committee.

Many of the difficulties and problems mentioned above can be satisfactorily ironed out at the Fifth Dental Congress of the F.O.L.A. which is to be held in Buenos Aires in 1944. The American Dental Association and the Canadian Dental Association have been asked to send an official delegation to the Convention. Because of war conditions it might be impossible for us to send a large delegation, but the Chairman sincerely hopes that our Association will send at least five delegates, so that they can enter into preliminary discussions with the officials of the F.O.L.A. with a view toward the formation of an Inter-American Dental Federation. The formation of such a federation would be a good thing, but the initial steps will be slow and complicated and the formulation of rules and regulations for such a federation will require considerable time, correspondence, patience, tact, statesmanship, and above all a sympathetic understanding of each country's individual problems.

Many members of the Association may reasonably ask why should the American Dental Association spend so much time and money on a foreign relations program. The best answer to this question is to quote from a letter recently received from the Secretary of State, Mr. Cordell Hull:

DEPARTMENT OF STATE
WASHINGTON

May 28, 1943

"My dear Dr. Lynch:

"I wish to thank you for your letter of May 11, 1943 with which you enclosed your Second Report of the Pan American Relations Committee of the American Dental Association.

"This report reveals the steady advance you and your colleagues are making in promoting closer relations among the dentists of the hemisphere, and thus contributing in no small measure to that international understanding which is fundamental to world peace.

"It is a source of satisfaction to me that the Department is able from time to time to furnish assistance and encouragement to your efforts.

Sincerely yours,

"(Signed) CORDELL HULL."

This letter is extremely pleasing to the Chairman of the Committee, and I believe that the Association can take a great deal of pride in the thoughts expressed by Mr. Hull. These are days of great social, economic and political change. The forces creating these changes touch and affect Dentistry, and therefore, it is essential that the organized profession of Dentistry know something about these forces and that we be in intimate contact with our colleagues in other countries, and with the Government officials responsible for the interchange of cultural and scientific programs. What is happening today in one country may be the forerunner of events in the United States tomorrow. If Dentistry does not take its rightful place in these programs now, we are very apt to find our profession represented by another health group, or what is worse, neglected entirely.

The dental motion pictures which were listed in the Second Report of the Committee have been completed with Spanish and Portuguese titles, and they are now ready for distribution. These films will be distributed by the Motion Picture Division, Office of the Coordinator of Inter-American Affairs, 444 Madison Avenue, New York City. Inquiries concerning them should be addressed to the Motion Picture Division at the above address. The Coordinator of Inter-American Affairs allocated $10,000.00 to the American Dental Association for this motion picture project, and it has been so successful that the Coordinator's office is considering a similar project with our Association for the coming year. Members of the Association having dental motion pictures that they would like to have considered for re-

production in Latin America, should communicate with the Chairman of the International Relations Committee.

One of the most successful projects which the Association has undertaken has been the Inter-American Post-Graduate Course in Dentistry which began on August 2, at the University of Michigan. This project is the result of the combined efforts of the W. K. Kellogg Foundation, the University of Michigan, the Department of State, and the Pan American Relations Committee of the American Dental Association. The W. K. Kellogg Foundation furnished maintenance, tuition, loan of instruments and travel expenses for all candidates while in the United States. The Department of State furnished transportation expenses from the candidate's home country to Ann Arbor, Michigan, and return. This whole project will have cost in the neighborhood of $50,000.00 before it is completed. The American Dental Association should take great pride in being associated with this program, and it is hoped that it will be so successful that it will be repeated in other years. The successful candidates for the course this year, and the countries they represent are listed below:

Argentina—Dr. Nicolas Parula, Monroe 3307, Buenos Aires, Argentina

Bolivia—Dr. Jose Ryes Morales—Callo Lansa 160, Cochabamba, Bolivia

Brazil—Dr. Ibanos Andrado Silva, Bua Marconi 94—8 andar, Sao Paulo, Brazil

Chile—Dr. Fernando Lara Bravo, Plasa Italia 05. 2 Piso Dep. 2, Santiago, Chile

Colombia—Dr. Ernesto Fajardo, Caucio 10-12-74, Bogata, Colombia

Costa Rica—Dr. Hernan Solanos Ulloa, P. O. Box 1668, San Jose, Costa Rica

Cuba—Dr. Carlos A. Criner, San Francisco No. 306 (altos), Havana, Cuba

Dominican Republic—Dr. Mario Antonio Batllo Vinas, Calle Jacuba, No. 31, Santiago, R. D.

Ecuador—Dr. Luis Anibal Egas Cortos, 80 Guayaquil Street, Quito, Ecuador

El Salvador—Dr. Mauricio Lopez Harrison, San Salvador, El Salvador, C. A.

Guatemala—Dr. Enrique Estrada N., 6 a Calle Oriente No. 2, Jocotenango, Guatemala City, Guatemala, C. A.

Haiti—Dr. Sosthone Daniel, 36 Bois Verna, Port-au-Prince, Haiti

Honduras—Dr. Guillermo Pineda, San Pedro Sula, Honduras, C. A.

Mexico—Dr. Enrique C. Aguilar Cutierrez, Palma Norte 330-308, Mexico, D. F.

Nicaragua—Dr. Fernando Medina, Managua, Nicaragua

Panama—Dr. Pedro Enrique Brin, Via Espana No. 33, Panama, Republic of Panama

Paraguay—Dr. Pierpont Inefran, Espana No. 523, Ascension, Paraguay

Peru—Dr. Guillermo Otero Gaymor, Patrocinio 118 (altos), Lima, Peru

Uruguay—Dr. Luis Alberto Trobo, Oral Arbigas 592, Las Piedras, Uruguay

Venezuela—Dr. Charles A. Brewer, Sur del Teatro Municipal 2, Caracas, Venezuela

Scholarships, postgraduate courses, travel grants and maintenance grants in the United States have been provided for a large number of dentists from Latin America during the past three years. It is reasonable to assume that in the near future our Latin American colleagues may want to reciprocate and, therefore, it is necessary that dentists in the United States be prepared to accept invitations to travel, lecture, study and demonstrate in the various other American Republics. Any American dentist accepting such an invitation assumes a great responsibility. Whether he knows it or not, he is representing American Den-

tistry. Therefore, he should be prepared to give his best in dentistry and in social conduct. One of the ways to assure the Latin American dental societies of the best American clinicians and essayists is for the American Dental Association to take charge of this work. All arrangements for lecturers, demonstrators and clinicians whether from Latin America or from the United States should be made through the International Relations Committee of the American Dental Association. Such a procedure will protect all parties concerned and will send to Latin America only properly qualified dentists who will be officially received by the ethical dental associations of each country. When a Latin American dentist of prominence visits the United States he will be assured of the same treatment.

Dentists in the United States who are interested in giving clinics in the other American Republics should have a working knowledge of Spanish or Portuguese. Dentists in Latin America with the same ideas should know and speak English. A lecturer cannot hold his audience if his hearers cannot understand him. Slides and moving pictures will help overcome the language difficulties, but they will not be enough. A knowledge of the language of the audience is most important.

During the past year, an important contribution to our work has been the publication of an "English-Spanish, Spanish-English Dental Vocabulary" by Joseph S. F. Marie. "This is a pioneer word-book in the field of practical dentistry and medicine giving exact translations from English to Spanish and vice versa. It presents more than 15,000 terms, in the two sections, selected from all branches of dentistry and related medicine. Operative dentistry has been given special attention. Names of instruments, office equipment, supplies, dental diseases, medicaments, orthodontic appliances and numerous anatomical terms have been listed and translated." This book should be available to every dentist who is interested in Inter-American relations and I am sure that its publication will aid considerably the exchange of dental knowledge among the Americas.

At the University of Michigan, a group of about fifteen dental professors have been studying Spanish during the past year. Individual dentists and groups throughout the United States have been doing the same thing, and the International Relations Committee views this trend with much pleasure. It is suggested that dental societies consider forming study groups to study Spanish.

In closing this report, the Chairman would like to enumerate certain practices which would facilitate the exchange of dental knowledge in the Western Hemisphere:

1. The study of Spanish by dentists in North America.

2. The study of English by dentists in Latin America.

3. By means of personal correspondence the establishment of friendships between the leaders of Dentistry in the United States and the leaders of Dentistry in the Latin American countries.

4. The establishment of professional intercourse through correspondence by dental research workers and practitioners in the United States with their colleagues in Latin America who are interested in the same fields of study.

This four-point program is possible of achievement. Individual members of the Association who are interested in Latin American relations and want to aid in the work should communicate with the Chairman of the Committee.

Respectfully submitted,

DANIEL F. LYNCH, *Chairman*

MIDWINTER MEETING CHICAGO DENTAL SOCIETY

THE 80th Annual Midwinter Meeting of the Chicago Dental Society will be held February 21-23, 1944 at the Palmer House, Chicago.

As a war emergency measure to conserve the time of busy dentists the 1944 meeting will be limited to three days rather than the customary four. The number of scientific sessions, however, has not been materially reduced. The program has merely been "streamlined" and concentrated into three full days of timely and practical sessions.

The theme of this Midwinter Meeting of the Chicago Dental Society will be "Prevention and Conservation in Dentistry" and will include discussions on war-time dentistry and rehabilitation. This program is extremely timely since the War has proved the great need for dental care and since prevention measures as a health service will undoubtedly be one of the future fields of great professional advancement. The program will offer an unexcelled opportunity for postgraduate study, as subjects of popular interest to all dentists—both general practitioners and specialists—will be discussed by recognized authorities in each field. These discussions will be informative and instructive, and designed to help increase the effectiveness of dentists as well as to record the most recent advances in dental science.

As in previous years, the program will consist of essays, limited attendance clinics, general clinics, motion pictures, general sessions and question and answer programs. These divisions of the program will present the many phases of dentistry both clinically and didactically, and will offer each dentist in attendance a wide range of subjects and clinicians from which to select those that are of greatest personal interest. Scientific and commercial exhibits, which are always particularly attractive features of this meeting, will also be presented. The commercial exhibit assembles under one roof all of the important manufacturers and distributors of dental supplies. It is the largest and most diversified exhibit in dentistry and deserves careful inspection by all.

Dentists in the various classifications of membership of the Chicago Dental Society, that is regular active, life, associate, etc., who are in good standing, and those dentists serving in the armed forces will be eligible to attend the 1944 meeting without payment of any additional fee. Out-of-town dentists who do not renew or acquire associate membership will be admitted to this meeting upon payment of a nominal registration fee of $2.00, provided they present evidence of membership in good standing in the American Dental Association, or a recognized foreign dental society.

OBITUARY

FRANK ADOLPH LEE
(1857-1943)

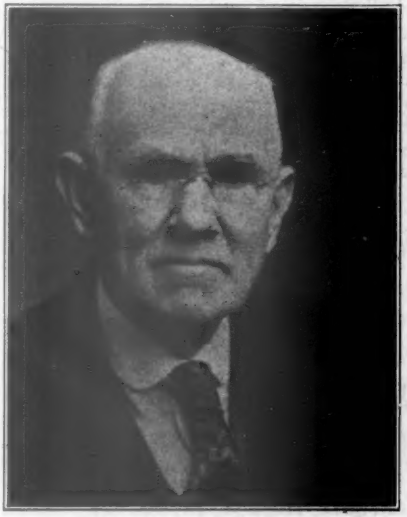
FRANK A. LEE, aged 86, Dean of the Dental Profession of Lynchburg, died August 17, 1943 in Lynchburg, Virginia, after an illness of two months.

Dr. Lee was born in Lynchburg in 1857. He graduated from the Baltimore College of Dental Surgeons in 1881. He was admitted to membership in the Virginia State Dental Association in 1884; was president of that organization, 1908-1909; was elected life member in 1918. He was a member of the Lynchburg Dental Society, the Piedmont Dental Society and the American Dental Association.

Dr. Lee practiced his profession continuously in Lynchburg for 62 years. For 21 years—from March 1922 to the close of the school session last June—he was employed by the City School Board in charge of the Dental Clinic for white children. He gave up private practice ten years ago, at which time he took over another clinic, in addition to the one mentioned above, under the direction of the Board of Health of Lynchburg.

He was the son of Dr. Ludwell G. Lee, pioneer dentist in Lynchburg, who was educated at Yale University and began practice in Lynchburg in 1840, continuing until a few years before his death in 1892.

The careers of father and son in the practice of dentistry in Lynchburg covered a continuous period of 103 years.



DR. FRANK ADOLPH LEE

Dr. Lee was active in social, church and civic affairs throughout his entire life. He will be missed by all who knew and loved him so well.

DEATHS

ANDERSON, E. O., Ardmore, Oklahoma; Vanderbilt University, School of Dentistry; died August 16; aged 58.

BAILEY, THOMAS C., Portland, Oregon; North Pacific College of Oregon, School of Dentistry, 1918; died September 23; aged 55.

BARTON, JOHN M., Rome, N. Y.; died October 14; aged 86.

BEAUMONT, G. A., Corpus Christi, Texas; Chicago College of Dental Surgery; died September 22; aged 58.

BLOOM, W. O., Worcester, Mass.; died October 2; aged 67.

BOYER, R. W., Marquette, Mich.; Chicago College of Dental Surgery, 1891; died October 11; aged 74.

BROWN, THOMAS, Chicago, Ill.; Northwestern

University Dental School, 1905; died September 19; aged 61.

CAHILL, J. VINCENT, Trenton, N. J.; The Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1919; died September 26; aged 46.

CALDWELL, OBE B., Parksville, Ky.; died August 20; aged 78.

CALHOUN, W. S., Norwood, Mo.; Kansas City Dental College, 1894; died September 4; aged 74.

CALLSEN, FERDINAND P., Redwood City, Calif.; College of Physicians and Surgeons of San Francisco, A School of Dentistry; died September 6; aged 50.

CHAMBERLAIN, DEAN L., Los Angeles, Calif. (formerly of Colorado Springs, Colo.); Denver College of Dentistry; died August 30.

CLEAR, FRANK A., Greenville, Ohio; University of Michigan, College of Dental Surgery, 1913; died July 17; aged 52.

COGAN, WILLIAM N., Washington, D. C.; Georgetown University School of Dentistry; died October 4; aged 87.

CORDRAY, ISAAC E., Blackwell, Ore.; died August 16; aged 75.

COSTA, RUDOLPH B., New Haven, Conn.; Temple University School of Dentistry; died October 4; aged 67.

COTTRELL, JAMES M., Hebron, Neb.; Omaha Dental College, Dental Department of the University of Omaha, 1903; died September 7; aged 75.

COURTWRIGHT, GEORGE S., New Lexington, Ohio; died October 16; aged 73.

CROZIER, SAMUEL BRUCE, Belmont, Ohio; Ohio Medical University, College of Dentistry, 1904; died October 3; aged 72.

CUBBEDGE, B. W., Guyton, Ga.; Baltimore College of Dental Surgery, 1887; died August 18; aged 77.

DITTBERNER, F. J., Milwaukee, Wis.; Marquette University, School of Dentistry, 1912; died September 27; aged 54.

DIXON, WILLARD R., Cleveland, Ohio; Western Reserve University, School of Dentistry, 1897; died July 7; aged 67.

DROWN, J. H., Brooklyn, N. Y.; Washington University School of Dentistry; died October 8; aged 76.

FAST, MALDEN J., Masontown, Pa.; University of Pittsburgh, School of Dentistry, 1915; died October 3; aged 49.

FAWCETT, WILLIAM D., Cambridge, Ohio; University of Pittsburgh, School of Dentistry, 1899; died September 29; aged 73.

FERRIS, HERSCHEL P., Cincinnati, Ohio; Cincinnati College of Dental Surgery, 1897; died July 21; aged 76.

GEROW, WILLIAM B., Cleveland, Ohio; Western Reserve University, School of Dentistry, 1905; died October 16.

GIDDENS, J. NEWTON, Meridian, Miss.; Baltimore College of Dental Surgery, 1892; died September 9.

HALEY, BYRON H., Newport, R. I.; Harvard University Dental School, 1911; died October 8; aged 57.

HAMMOND, E. L., Las Vegas, N. Mexico; Temple University School of Dentistry, 1901; died September 20; aged 67.

HAMMOND, H. R., Fruita, Colo.; Cincinnati College of Dental Surgery, 1894; died August 12; aged 70.

HAUSMANN, WILLIAM, SR., West Bend, Wis.; Chicago College of Dental Surgery, Dental Department of Loyola University, 1901; died October 8; aged 64.

HAVERFIELD, CALVIN L., Columbus, Ohio; Ohio Medical University, College of Dentistry, 1902; died October 16; aged 65.

HERRICK, BENJAMIN A., Redwing, Minn.; University of Minnesota, College of Dentistry, 1897; died October 3; aged 69.

HETTIG, A. F., Rochester, N. Y.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1906; died September 16; aged 63.

JONES, OSCAR D., SR., Baltimore, Md.; Howard University, College of Dentistry, 1911; died July 29.

JONES, RUSSELL, Waukesha, Wis.; Marquette University School of Dentistry, 1928; died October 2. Dr. Jones had been serving in North Africa with the 79th station hospital.

KECK, H. F., Columbus, Ohio; died October 17.

KELLER, HERBERT, Jersey City, N. J.; University of Maryland, School of Dentistry and the Baltimore College of Dental Surgery, 1914; died October 11; aged 53.

LACY, BELLE FAIRBANKS, Bayfield, Colo.; died September 12; aged 90.

LAKE, FREDERICK W., Boston, Mass.; Tufts College Dental School, 1922; died October 6; aged 56.

LAMBERT, ALFRED L., West Milton, Ohio,

(formerly of Dayton); Ohio Medical University, College of Dentistry, 1901; died October 1; aged 75.

LASHER, CARL W., Carthage, N. Y.; University of Buffalo, School of Dentistry, 1911; died October 3; aged 55.

LEITH, GEORGE W., Lowell, Mass.; Tufts College Dental School, 1901; died September 21; aged 75.

LINDSAY, CHARLES M., Boulder Creek, Calif.; died September 16; aged 74.

LITTLETON, GILBERT C., Springfield, Ohio; Ohio College of Dental Surgery, Dental Department of the University of Cincinnati, 1905; died October 4; aged 65.

LYLE, ARTHUR G., Chicago, Ill.; University of Illinois, College of Dentistry, 1905; died October 7; aged 61.

MCCARTHY, I. J., Chicago, Ill.; died October 10; aged 45.

MCCARTNEY, F. M., Cleveland, Ohio; University of Michigan, College of Dental Surgery, 1890; died August 30; aged 75.

MCCLAREN, J. M., Pittsburgh, Pa.; Pennsylvania College of Dental Surgery, 1883; died September 23.

MCCLURE, C. E., Henderson, Ky.; University of Louisville, School of Dentistry, 1903; died July 18; aged 66.

MCGARRELL, JAMES J., Indianapolis, Ind.; Indiana University School of Dentistry, 1924; died October 25; aged 44.

MCKELVEY, CHARLES V., Cleveland, Ohio; University of Pittsburgh, School of Dentistry; died September 22.

MCLARTY, CHARLES, Stroud, Okla.; died June 30.

MCLAUGHLIN, JOHN H., Hibbing, Minn.; University of Minnesota, College of Dentistry; died September 22; aged 30.

MCMILLAN, J. L., Youngstown, Ohio; died recently; aged 67.

MACFARLANE, FRANCIS J., Milton, Mass. (formerly of Boston); Tufts College Dental School, 1883; died October 2; aged 82.

MANTERNACH, PAUL, St. Paul, Minn.; University of Minnesota, College of Dentistry, 1916; died October 18; aged 52.

MILLIGAN, WILLIAM S., Saginaw, Mich.; Northwestern College of Dental Surgery, 1891; died October 11; aged 77.

MINER, R. R., Longmont, Colo.; University of Nebraska, School of Dentistry, 1927; died July 27; aged 44.

MITCHELL, A. R., Portland, Ore. (formerly of Albany, Ore.); Northwestern University Dental School, 1909; died September 16.

MORGAN, EGLAN THOMAS, Atlanta, Ga.; University of Louisville, School of Dentistry, 1887; died September 19; aged 82.

MORRIS, EVERETT L., Cincinnati, Ohio; Cincinnati College of Dental Surgery, 1919; died June 18; aged 53.

MORRIS, LUTHER E., Mt. Healthy, Ohio; Cincinnati College of Dental Surgery, 1919; died June 18.

NETHERLAND, FRANK B., Washington, D. C.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1915; died September 24; aged 50.

PAINE, THOMAS, Houston, Tex. (formerly of New York, N. Y.); was killed by a train, August 14. Dr. Paine was 87 years old.

PALMER, A. B., Seattle, Wash. (formerly of Newton, Iowa); died recently.

PITMAN, CARL B., Atlanta, Ga.; Atlanta-Southern Dental College, 1925; died September 24; aged 47.

POFF, DELBERT W., Waukegan, Ill. (formerly of Winnetka, Ill.); St. Louis University School of Dentistry, 1911; died September 11; aged 58.

POWELL, W. D., Birmingham, Ala.; Birmingham Dental College, 1909; died September 7; aged 65.

POWERS, GEORGE L., JR., Memphis, Tenn.; University of Tennessee, College of Dentistry, 1930; died August 23 in Saranac, N. Y.; aged 35. Dr. Powers was on the faculty of the University of Tennessee.

POWERS, ROGER P., Albion, Mich.; University of Michigan, College of Dental Surgery; died October 2; aged 41.

RANDALL, GEORGE T., Omaha, Nebr.; Northwestern University Dental School, 1918; died June 12; aged 57.

RATNER, SAMUEL, CAPT., Philadelphia, Pa.; died October 28; aged 44.

RAUDABAUGH, G. M., St. Mary's, Ohio; Ohio Medical University, College of Dentistry, 1904; died July 25; aged 67.

RHINEHART, EDWARD BERHANS, Schenectady, N. Y.; Chicago College of Dental Surgery, 1897; died September 8; aged 68.

RICHTER, G. B., Cleveland, Ohio; Western Reserve University School of Dentistry, 1929; died July 28.

ROCKEY, JOHN A., Sunbury, Ohio; Ohio State

University, College of Dentistry, 1899; died August 15; aged 65.

RODGERS, NEVELL K., Washington, D. C.; Georgetown University, School of Dentistry, 1918; died August 15; aged 80.

RORK, R. N., Durand, Wis.; University of Illinois, College of Dentistry, 1902; died August 6; aged 68.

ROSS, JAMES HOWELL, St. Joseph, Mo.; Pennsylvania College of Dental Surgery, 1892; died August 14; aged 75.

ROSS, WILLIAM F., St. Joseph, Mo.; University of Louisville, School of Dentistry, 1896; died August 4; aged 72. He was a brother of James Howell Ross, with whom he was in practice.

ROSSITER, VINCENT A., Santa Ana, Calif.; University of Southern California, College of Dentistry, 1906; died August 23; aged 58.

ROWAN, J. W., Atlanta, Ga.; died September 17; aged 70.

RUPERT, GLADE EDWARDS, Albion, Ind. (formerly of Ligonier, Ind.); University of Indiana, School of Dentistry, 1915; died August 23; aged 50.

SACK, HERMAN B., Richmond Hill, N. Y.; College of Dental and Oral Surgery of New York, 1918; died August 25; aged 49.

SCHALLHEIM, ARTHUR, Cleveland Heights, Ohio; Western Reserve University, School of Dentistry, 1913; died June 29; aged 48.

SCHEBLE, E. S., Fort Worth, Texas; died October 6; aged 72.

SCOTT, STARLING M., Lancaster, Ohio; College of Dental Surgery, Dental Department of the University of Cincinnati, 1905; died July 28; aged 62.

SEITZ, WILLIAM J., Toledo, Ohio; University of Michigan, College of Dental Surgery, 1909; died in April; aged 60.

SETZER, ERNEST M., San Francisco, Calif.; died September 29; aged 47.

SHAFER, LEROY, Columbus, Ohio; Ohio Medical University, College of Dentistry, 1906; died September 17; aged 57.

SHIELDS, SCOTT W., Brownstown, Ind.; Indiana University School of Dentistry, 1910; died October 6; aged 55.

SIMMS, J. D., Wichita Falls, Texas; Northwestern University Dental School, 1904; died August 18; aged 66.

SLADE, WILLIAM E., Brockton, Mass.; died October 1; aged 56.

SLOAN, GEORGE ALFRED, Kittanning, Pa. (formerly of Braddock and Wilkinsburg, Pa.); died September 3; aged 76.

SMITH, F. G., East St. Louis, Ill.; Washington University School of Dentistry, 1909; died October 8; aged 56.

SMITH, WILLIAM G., Freeport, N. Y.; Pennsylvania College of Dental Surgery, 1880; died September 25; aged 85.

SORGEN, Carl G., Butler, Pa.; University of Pittsburgh, School of Dentistry, 1912; died June 21; aged 58.

SOPER, FRED L., Pittsburgh, Pa.; Western Dental College, 1917; died May 14, at the Army air base at Santa Ana, Calif.; aged 46.

SPALDING, LOUIS N., Springfield, Mo.; St. Louis University School of Dentistry, 1911; died in July; aged 53.

SPARGUR, WILLIAM F., Wellsville, N. Y.; Western Reserve University, School of Dentistry, 1897; died September 17; aged 70.

STAIRE, HARRY M., Oxnard, Calif.; Washington University School of Dentistry, 1887; died August 20; aged 84.

STEARNS, GEORGE F.; New Britain, Conn.; Temple University School of Dentistry, 1900; died October 4; aged 68.

STILES, WILLIAM E., East Northrup, N. Y.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1894; died September 17; aged 79. Dr. Stiles was also a graduate in medicine.

STONE, EDWARD, Chicago, Ill.; Chicago College of Dental Surgery, 1919; died May 6.

STOUT, EDWARD D., Philadelphia, Pa.; Temple University School of Dentistry, 1899; died September 29.

STOVER, JAMES MCNAIR, South Boston, Va.; University College of Medicine, Dental Department, Richmond, 1902; died October 14; aged 73.

STRECKER, ALBERT W., Philadelphia, Pa.; Pennsylvania College of Dental Surgery, 1900; died September 29; aged 68.

SUND, CLARENCE W., Cleveland, Ohio; Western Reserve University, School of Dentistry, 1918; died July 18; aged 48.

SUTTON, FRANK W., Glendale, Calif.; Chicago College of Dental Surgery, 1902; died May 22; aged 66.

SWEET, ELI J., Hornell, N. Y.; University of Buffalo, School of Dentistry, 1898; died July 16; aged 82.

TAYLOR, BRUCE L., Washington, D. C., National University, Dental Department, 1906; died July 1; aged 72.

TAYLOR, GEORGE PIKE, Reynoldsburg, Ohio; Ohio State University, College of Dentistry, 1915; died July 12.

TELLMAN, JOSEPH G., Belle, Mo.; Washington University School of Dentistry, 1904; died May 27; aged 66.

THOMAS, WILLIAM ALBERT, Evanston, Ill.; Northwestern University Dental School, 1901; died July 19.

THOMPSON, GEORGE H., Fulton, Ill.; University of Louisville, School of Dentistry, 1901; died May 21; aged 65.

TISS, JULIAN MICHAEL, Utica, N. Y.; University of Buffalo, School of Dentistry, 1912; died September 19; aged 53.

TREGILLIS, KERMIT, Lincoln, Calif. (formerly of Duluth, Minn.); died in a motor accident recently.

TRONSON, CHARLES W., Kingston, N. Y.; died recently when struck by a motorcycle. Dr. Tronson was 73 years old.

TUCKER, ARTHUR V., East Rockaway, N. Y.; died May 23.

TUCKER, LESLIE S., Fort Wayne, Ind.; Indiana University School of Dentistry, 1908; died September 10; aged 56.

TURCOTTE, R. D., Baltimore College of Dental Surgery, 1914; died September 11; aged 50.

TURNER, RAYMOND C., Oswego, N. Y.; Temple University School of Dentistry, 1899; died July 11; aged 67.

VIETOR, RUSSELL I., Grand Rapids, Mich.; Northwestern University Dental School, 1926; died September 6; aged 44.

VOLKERT, PAUL JOSEPH, Tipp City, Ohio (formerly of Cedarville, Ohio); Ohio State University, College of Dentistry, 1934; died July 25, from injuries sustained in a fall from a tree. Dr. Volkert was 40 years old.

WAGNER, ARTHUR W., Belleville, Ill.; St. Louis University School of Dentistry, 1916; died June 13; aged 54.

WAINWRIGHT, J. A., Farmersville, La.; Tulane University of Louisiana, College of Medicine, School of Dentistry, 1917; died May 13.

WALLACE, WILLIAM R. J., Rochester, N. Y.; School of Dentistry, University of Pennsylvania, 1908; died July 11; aged 60.

WALSH, ELMO LAWRENCE, Eureka, Calif.; College of Physicians and Surgeons of San Francisco, A School of Dentistry, 1918; died August 11; aged 48.

WATKNS, CHARLES B., Barneveld, N. Y.; died July 4; aged 90.

WATKINS, G. L., Pueblo, Colo.; Detroit College of Medicine, Department of Dental Surgery, 1906; died July 9.

WATTS, CLARENCE V., Des Moines, Iowa; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1891; died in St. Louis, Mo., while on his way to Mexico City for an extended stay. Dr. Watts was 76 years old.

WATTS, W. W., Beckley, W. Va., died September 25; aged 69.

WEARSTLER, HOWARD O., Barberton, Ohio; Western Reserve University, School of Dentistry, 1902; died March 23; aged 68.

WEIL, H. J., St. John, Kan.; University of Louisville, School of Dentistry, 1909; died June 14.

WELLS, H. A., Cheney, Wash.; University of Minnesota, College of Dentistry; died August 30; aged 91.

WERTZBERGER, H. J., Alma, Kan.; Western Dental College, 1901; died July 10; aged 62.

WEST, HAROLD T., Park Falls, Wis.; University of Illinois, College of Dentistry, 1919; died April 29; aged 67.

WHEELER, GILMAN A., Randolph, Vt.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania; died September 23; aged 75.

WHITE, FRANK K., Phillipsburg, Pa.; Baltimore College of Dental Surgery, 1885; died August 5.

WHITE, LEO L., Kansas City, Mo.; died October 4; aged 41.

WHITEHILL, ROBERT, Boston, Mass.; Harvard University Dental School, 1901; died October 21; aged 69.

WHITLEY, ARTHUR C., St. Louis, Mo.; St. Louis University School of Dentistry, 1910; died September 24; aged 55.

WHITESHIELD, CHARLES F., Trout Creek, Mich.; died September 26; aged 80.

WILBER, ERNEST E., Hastings, Nebr.; Iowa Dental College, 1895; died June 3; aged 72.

WILD, ALBERT C., Whitewater, Wis.; died May 16; aged 93.

CURRENT LITERATURE

Journal of Dental Research
August 1943

Titles marked with an asterisk (*) are reviewed below.

*Flow of Methyl Methacrylates. Arthur B. Gabel and E. Howell Smith, University of Pennsylvania—237.

Mechanism of Fluorine Inhibition of Caries in the Rat. Rudolph W. Norvold and W. D. Armstrong, University of Minnesota—243.

The Mechanism by which Iodoacetic Acid Inhibits Experimental Dental Caries in the Rat. Vernon H. Powell and Peter P. Dale, University of Rochester—257.

*Effect of Pregnancy on the Chemical Composition of Human Dentin. David A. Dragiff and Maxwell Karshan, Columbia University—261.

*Anthropological Studies in Dental Caries. Meyer Klatsky and Jack S. Klatell, New York, N. Y.—267.

*Effect of Age on the Incidence of Experimental Caries in Normal and Castrate Rats. Harold C. Hodge, University of Rochester—275.

*Tooth Condition, a Factor in Experimental Isotope Absorption. Charles F. Bodecker, Columbia University—281.

*Further Observations on Dental Lymph in the Dentin. William Lefkowitz, Columbia University—287.

*Initial Oxidation—Reduction Potentials of Saliva. L. L. Eisenbrandt, University of Kansas City—293.

Clinical and Bacteriological Study of 340 Pulp Therapy Cases. Raymond L. Hayes, Howard University—301.

*Studies on the Incidence and Cause of Dental Defects in Children. III. Gingivitis. Marcu Brucker, New York—309.

*Studies on the Incidence and Cause of Dental Defects in Children. IV. Malocclusion—315.

*Heat Impact of Revolving Instruments on Vital Dentin Tubules. Chester J. Henschel, New York—323.

The Relationship of Particle Size and Other Properties of Dentifrice Ingredients to Toothbrush Abrasion of Enamel. Sidney Epstein and M. L. Tainter, College of Physicians and Surgeons, San Francisco—335.

International Association for Dental Research. Scientific Proceedings of the New York Section. Frances Krasnow, Guggenheim Dental Clinic—345.

Flow of Methyl Methacrylates

THERE is a general lack of understanding of the behavior of methyl methacrylates under load, particularly with regard to permanent deformation. If this material possesses the property of flow to any great extent, its use in many types of restorative dentistry would be contraindicated since this effect is cumulative.

In this study, small cylinders were compressed in a Tinius Olsen crushing strength testing machine modified so that a predetermined load could be applied and the compression read by the movement of a pointer attached to the load arm.

The compression-time graph, except at the start, was definitely exponential in character as was also the recovery graph.

As has been anticipated, recovery was not complete. It seemed to vary with the extent and duration of compression.

The exponential form of the curves indicates a slowing down and finally a cessation of change which is of especial interest in regard to compression. The slowing down of the rate of change is apparently due to internal friction, which may be partly responsible for the failure to recover completely.

Effect of Pregnancy on the Chemical Composition of Human Dentin

ROOT dentin of thirty-one teeth of pregnant women, and twenty-one teeth of non-pregnant women, was analyzed for percentages of ash, calcium and phosphorus. No differences were found between the two groups. When the teeth were grouped according to month of pregnancy, number of previous pregnancies and age of the individual, no differences were observed. It appears, therefore, that the percentages of calcium, phosphorus and ash of the root dentin of humans are not influenced by pregnancy. This indicates that there is no basis for the view that minerals

are withdrawn from the teeth of humans during pregnancy.

Anthropological Studies in Dental Caries

THE incidence of dental caries among various peoples of diverse periods was investigated. In all, 4,000 skulls and 38,300 teeth were examined. Of the forty-six geographical groups, six showed no caries. The more primitive groups tended to have a lower incidence of dental decay than the more modern and civilized peoples. Anatomic studies of the masticatory apparatus of all the groups show that the jaw bones of the primitives were better developed and the teeth evinced greater attrition than those of modern peoples. This attests to the higher degree of function of the masticatory apparatus of these races. There is an inverse proportion between masticatory function and the incidence of dental caries. Lack of dental function is an important factor in the causation of caries among modern peoples.

Effect of Age on the Incidence of Experimental Caries in Normal and Castrate Female Rats

1. SEVENTEEN normal and twelve castrate female rats were placed at the age of 1 year on the coarse corn diet which was ingested up to nineteen months thereafter.

2. No differences were observed between the caries incidence in the normal and in the castrate rats.

3. These rats developed caries much more slowly than do weanling rats placed on the same diet.

4. After eighteen months on the diet, all the surviving rats had caries.

Experimental Isotope Absorption: Tooth Condition

THE amount of radio-active phosphorus defined in dental tissues as a result of experiments designed to determine the degree of their metabolic activity is dependent largely upon the age of the tooth, type of the animal, secondary dentin formation, protective metamorphosis, degree of attrition and pulp vitality. All of these factors affect the permeability of teeth, a quality closely related to physiological phenomena. If protective metamorphosis has occurred owing to ageing, attrition and secondary dentin formation, permeability of the dentin is reduced greatly; hence, very little radio-active phosphorus can pass from the pulp into the dentin and enamel. The teeth of animals used for purposes of defining metabolic activity should be examined as to their permeability because this factor will affect the results of the experiment.

The degree of pulp activity also plays a rôle in the degree of metabolic activity in dentin and enamel. Pulp extirpation leads to a vast temporary increase in permeability in recently erupted teeth, causing the absorption of radio-active phosphorus from channels other than the dental pulp. Thus a confusion results, suggesting that the dental pulp is unimportant in effecting metabolic changes in the tooth.

Further Observations of Dental Lymph in the Dentin

THE rate of flow of dental lymph from the odontoblast to the terminus of Tomes fibril has been measured in the teeth of dogs. A dye, inserted into the pulp, reached its maximum diffusion in thirty-eight minutes. The entire body of the dentin was stained except the apical third of the root. A marked difference in the intensity of the stain was observed between the area of the cut tubules and the remainder of the dentin which exhibited minute particles in the tubules.

Examination of transverse sections of dentinal tubules in the predentin demonstrated that the dye diffused outward through Tomes' fibrils. This was also observed in isolated Tomes' fibrils.

Afferent and efferent flow of dental lymph may be observed in a young human specimen in which the dye was placed in a stain pocket at the incisal area of the dentin. The dye was transported to the pulp and redistributed throughout the crown in the same manner as that found after insertion of the dye into the pulp.

The presence of cells in the dentin, previously reported caused by suction produced by forceps in extraction, was observed in the dentin over the incisal horn of the pulp. No forceps were used in dissecting the specimen.

Initial Oxidation-Reduction Potentials of Saliva

TEMPORARY oxidation-reduction potentials of unstimulated saliva of five healthy subjects were determined immediately after expectoration into a sample cup. The results

were expressed as E_H in mv. The tests totaled 252 and were run for ten to twelve days at bi-hourly intervals beginning at 9 A.M.

The mean E_H was +261 mv. The subjects did not deviate significantly from the mean, and they did not vary significantly from one another as determined by an analysis of variance.

The E_H for the group became less at each bi-hourly interval as the day progressed; the greatest change occurred between 9 and 11 a.m. (+270 and +256, respectively). No subject deviated significantly from each bi-hourly mean. An analysis of variance showed that the variations among the 5 bi-hourly means were not significantly variable.

Therefore, in this experiment, the E_H of saliva exhibited no marked characteristics among the subjects, and none were observed for the bi-hourly periods during the day, thereby placing importance upon the mean E_H of +261 mv.

Studies on the Incidence and Cause of Dental Defects in Children. III. Gingivitis

THIS study of 1,634 public school children showed that a connection between the incidence of caries and that of gingivitis is difficult to establish. The data amassed substantiate the views of those who uphold the doctrine that the state of teeth is correlated with that of the gingivae; that is, good gingivae are more apt to be found associated with clean teeth, fair gingivae with teeth that are fairly clean and diseased gingivae with dirty teeth.

Warm climates seem to exert no inhibitory influence on the incidence of the disease.

Studies on the Incidence and Cause of Dental Defects in Children. IV. Malocclusion

THIS study of 1,668 school children of Newark, New Jersey, showed that the incidence of caries in children having malocclusion of the transitional dentition was higher than in those free from the disorder. Also the incidence of caries in children having true malocclusion was higher than in those free from malocclusion. Non-Jewish children having malocclusion of the deciduous, transitional or permanent dentition showed a higher incidence of dental decay than Jewish children afflicted with these disorders.

Nineteen per cent of the total number of pupils studied had true malocclusion and in them 29 per cent of the total number of cavities was recorded. The influence of malocclusion on the incidence of dental decay has thus been demonstrated.

Heat Impact of Revolving Instruments on Vital Dentin Tubules

THERMAL abuse from revolving dental instruments falls into: A—general tooth temperature rise, B—intolerable temperature rise at the cut surface of vital dentin tubules. Many authorities attribute much operative pain to frictional heat, a theory confirmed by the practice of "Thermal Control" by our graduate group. The author's earlier work on this subject indicated that a rise of more than 25° F. must accompany the gentlest use of the smallest bur. This contradicted otherwise accepted research which showed negligible thermal shock from light pressure and small burs.

New experiments from a different point of view (type B) measured the total caloric generation of revolving instruments. The heat impact on dentin tubules was calculated from the caloric recording, considering the weight, specific gravity and specific heat of the substance involved. The specific heat of average dentin was determined at 0.3. The thermal impact on cut dentin surface ranges from a 67° F. rise during gentle operating to a possible rise of 1000° F. in abuse.

It is concluded that dry field operative dentistry is contraindicated where revolving instruments are used and pain control is believed important. Electrically synchronized "Thermal Control" apparatus (fine stream 100 °F. water) has been perfected, permitting dental engine preparation free from heat trauma, and no more painful, but faster, than hand instrumentation.

Aerodontia

C. E. WILLHELMY

A SHORT summary is offered of the present-day information regarding dentistry as related to aviation. Brief considerations are given to: (1) necessity for elimination of oral infection, (2) dangers of removable appliances and hazards of fixed points, (3) ear symptoms due to loss of vertical dimension

and compression of the eustachian tubes, (4) effect of altitude and low temperatures on teeth and restorations, (5) periodontitis, (6) effect of flight on the dental pulp and (7) gingival inflammation as increased by flying.—*D. Digest,* 49:311, July 1943.

DAVID B. SCOTT.

Cementomas—A Report of Fifty Cases

E. V. ZEGARELLI and D. E. ZISKIN

FROM diagnosis based upon roentgenographic evidence, clinical observations and pulp vitality tests, it was found that cementomas occurred exclusively in women in the group studied, being more frequent in negroes (8 to 1). There was no demonstrable relationship of caries or restorations and trauma to the incidence of cementomas. No systemic diseases were found that could be correlated with cementomas, and endocrine, metabolic or racial explanations of their etiology may ultimately prevail.—*Am. J. Orthodontics,* 29:285, May 1943.

S. J. FANALE.

Dental Developments in Congenital Syphilis

BERNARD G. SARNAT and NOEL G. SHAW

TWENTY-TWO of seventy-three patients with congenital syphilis showed dental changes characteristic of this disease, which undergoes exacerbation during the neonatal period and infancy. It affects the particular stage of tooth development active at the time. The effects are different in the growing deciduous and permanent teeth. Any convergence of the proximal surfaces of permanent upper central incisors should not be confused with disturbances of enamel formation which may take place at a later time. No correlation was observed between the severity of the disease in the neonatal period and earliest infancy and dental development. These developmental disturbances can be demonstrated roentgenographically prior to eruption.—*Am. J. Orthodontics,* 29:270, May 1943.

S. J. FANALE.

Danger Attending the Use of Ammoniacal Solutions of Silver

By G. S. SMITH

AMMONIACAL silver nitrate solutions should be used as soon as possible after preparation. They should not be stored or kept in bottles, as they may become explosive after varying periods of time. Fulminating silver crystals are believed to be formed on standing, especially at summer temperatures. This substance is sensitive to percussion, friction, heat, etc. Several laboratory explosions are described.—*J. Path. & Bact.,* 55:227, April 1943.

DAVID B. SCOTT.

Sodium Pentothal Anesthesia in Intra-Oral Surgery at Sea

C. R. CARR and D. E. LAMOTHE

ADAPTATION of sodium pentothal anesthesia to war surgery has given its use a new impetus. In many cases, the drug is more convenient as compared with other agents, especially on ships. There are no deleterious effects from respiratory depression if the patient is given adequate amounts of oxygen during the anesthetic period. The simultaneous administration of oxygen is becoming a general rule, since this overcomes the main objection to the agent for intra-oral surgery.—*U. S. Nav. M. Bull.,* 41:1374, August 1943.

S. J. FANALE.

Pterygopalatine Injection for Block Anesthesia of the Maxilla

R. M. RANKOW

AVOIDANCE of multiple maxillary injections in local anesthesia for oral surgical procedures can be easily accomplished by resorting to injection of the anesthetic into the pterygopalatine fossa through the greater palatine foramen. The technic of injection is relatively simple when aided by a knowledge of the essential anatomy. The operator must make certain that the needle is in the foramen and, when its point is in the pterygopalatine fossa, should inject slowly, allowing adequate diffusion. Symptoms of anesthesia follow in about one and one-half minutes with complete loss of sensation from the upper lip and infra-orbital region of the face in from six to eight minutes, indicating the area innervated by the anesthesia of the terminals of the infra-orbital nerve, and profound anesthesia of the maxilla.—*Mil. Surg.,* 93:164, August 1943.

S. J. FANALE.

Diagnosis of Cervical Metastasis from Squamous Carcinoma of Mouth and Throat

C. A. WHITCOMB

THE physical diagnosis of a metastatic squamous carcinoma of the cervical lymph nodes depends on the discovery of a primary cancer and the presence of a particular kind of regional adenopathy. A few cases have more than one metastatic node, and the primary cancers in such cases are more often in the pharynx than in the mouth, on the lip or on the face. The percentage of occurrence of metastasis is approximately 25 in cancer of the lip, 50 in cancer of the mouth and 25 in cancer of the throat. Clinical diagnosis of slight metastases is difficult. In many cases, cancer cells are present in the lymph vessels as well as in the lymph nodes. The clinical diagnosis must be confirmed by microscopic examination. Complete block dissection provides the only kind of specimen which affords an opportunity to study the complete histopathologic picture of the involvement of the lymphatic structures of the neck by cancer cells. A careful physical examination is important in the diagnosis and prognosis of metastasis.—*Am. J. Roentgenol.*, 50:219, August 1943.

S. J. FANALE.

On the Growth of the Jaws and the Eruption of the Teeth

ALLAN G. BRODIE

SERIAL cephalometric roentgenography of living individuals from birth to eight years reveals that at birth the jaws are apart, but that the mandible has already assumed the angular relation to the head which will be characteristic throughout life. The tongue occupies the interjaw space before teeth are erupted. The nose constitutes approximately 43 per cent of face height regardless of age.

Anterior facial landmarks go downward and forward on a series of straight lines, posterior facial points go straight downward except gonion which goes downward and slightly backward. There is no change in the angle of the mandible.

Alizarination of growing macaque monkeys reveals that although development is downward and forward, bone apposition is upward and backward. Growth sites are found on the maxillary sides of the frontomaxillary, zygomaticomaxillary and pterygomaxillary junctions and in the mandible on the alveolar border, posterior border of ramus and head of condyle. The condyle contributes more growth than any other site in the face.

Interpretation permitted by the combination of these two methods reveals a vertical course of eruption of the teeth although accompanied by certain axial changes in their crypts. Upper molars rotate mesiopalatally and lower distobuccally during eruption. The upper and lower first permanent molars bear strikingly constant relations to the cranial base and mandible respectively.—*Angle Orthodontist*, 12:3, July 1942.

Can Dental Health Care Be Provided for the Total Population?

H. B. G. ROBINSON

DENTAL service must be adjusted to changing social concepts and must provide care for the people of all classes. Programs to assure health care have been introduced in Congress from time to time and have been opposed by the health professions. The amended social security bill now under consideration (S. 1161) is opposed by medicine and dentistry, but we must offer some workable plan rather than simple criticism. The Council on Dental Health has been assigned a major role in this problem of social consideration. Dental care can be insured, among those of a young age group, on a plan similar to the Blue Cross plan of group hospitalization. This plan would not limit the choice of dentist, the type of work performed or the fee charged by the dentist. Indigents must be cared for from public funds and this may be done most economically by utilizing existing facilities and employing young graduates on an experience gaining basis. Research must be continued and expanded so that 70,000 dentists may care for 130 million people.—*J. Missouri State D. A.*, 23:163-167, September 1943.

Electrolytic Action in Dental Appliances

A. B. MACGREGOR and B. W. FICKLING

IN three cases of fractured mandible in which treatment consisted of bone grafting and extra-oral fixation, electrolytic action developed between the copper-silver dental splint and the chromium plated steel pins, causing ulceration, delayed healing and bone necrosis. Sequestra formed around the pin holes. Electrolytic action may also account

for ulceration around screws, soldered joints, etc., on extra-oral splints. Preventive measures include the use of non-conductive plastic as connecting bar material, and stainless steel pins and screws.—*Lancet*, 6262:290, September 4, 1943.

DAVID B. SCOTT.

Galvanic Batteries in the Human Mouth —Chase-Lain-Goldstein Syndrome

H. I. GOLDSTEIN

THIS review offers historical and bibliographical evidence of electrical phenomena occurring in the mouth due to the presence of dissimilar metals, along with personal observations based upon many years of clinical study. Very often abnormal sensations in and about the mouth, soreness, ulceration, tingling, and burning pains are attributed to vitamin deficiency, endocrinopathy, allergy, and focal infection, but when treated by the various therapeutic measures for such affections, the conditions are often not completely relieved. It has been noted that often the best clinical results are obtained when in addition all sources of electrical potentials, such as restorations composed of dissimilar metals are removed. Consideration in diagnosis should be given to the possibility of galvanic phenomena. Further study on the subject is advocated.—*Rev. Gastroenter.*, 10:206, July 1943.

DAVID B. SCOTT.

Idiosyncrasy to Metallic Mercury with Special Reference to Amalgam Fillings in the Teeth

M. H. BASS

THREE cases of idiosyncrasy to metallic mercury are described. All occurred in children known to be susceptible to mercury applied to the skin. In two instances, the active agent was mercury applied to the skin, and in two, amalgam restorations were the etiologic factor. In one of the latter symptoms of severe urticaria continued until removal of the fillings. Most research on idiosyncrasy to dental mercury appears in the German literature, and explanations offered include inhalation of air which contains mercury emanating from new fillings, hypersensitivity of unknown origin, and direct absorption of mercury through the gingiva from particles left in the mouth after insertion of restorations.—*J. Pediat.*, 23:215, August 1943.

DAVID B. SCOTT.

Sperm Fluctuations in Health and Disease

R. D. BROWN

WEEKLY ejaculates from senior medical students were studied in an attempt to see if clinical febrile states and other environmental factors affected measurably the sperm. Common febrile states, as upper respiratory infection, influenza, and coryza decrease the resistance of spermatozoa to spermicides and to normal ageing processes. Such devitalization of spermatozoa is probably responsible for the frequently observed temporary sterility resulting from febrile states. Ulcerous membranous stomatitis produced a transient aspermia with a concurrent obligatory sterility. This was followed by production of devitalized and morphologically abnormal spermatozoa, which probably resulted from abnormal spermatogenesis. Sexual excess also decreased the volume of the sperm and spermatozoa, but spermicidal and ageing time remained at fertilizing levels.—*Southern M. J.*, 36:619, September 1943.

DAVID B. SCOTT.

Tumors of the Neck

EDWARD W. PETERSON

EXCEPTING the abdomen, there is no other part of the body with so great a variety of inflammatory swellings and new growths as the neck. The diagnosis of neck tumors is not usually difficult if the history, physical findings and laboratory findings are carefully weighed. The future management of serious neck infections is to be influenced favorably by sulfonamide therapy. Cysts of the neck give rise to but few symptoms, other than the deformity produced, unless infection complicates the picture. After operation, healing is usually prompt and permanent. A classification of neck tumors is included and the subjects of congenital cysts and fistulas are given special emphasis. The essential factor in effecting a cure is complete surgical excision.—*Am. J. Surg.*, 41: 350, September 1943.

S. J. FANALE.

Extraoral Roentgen Technic in Fractures of the Mandible, Maxilla and Associated Structures

EDGAR L. ABT

IN making a thorough roentgen examination in the study of fractures, we must keep in mind: (1) maximum structural detail for any tissue changes; (2) showing the entire involved area; (3) showing of possibly involved adjacent tissues, and (4) showing of 2 views of each anatomic part, one at a right angle to the other. With the case history at hand one can determine the views necessary to best depict the fractures. It is advisable to use a limiting diaphragm or cone to prevent the more divergent rays from causing distortion and to cut down on the amount of secondary radiation. A comprehensive understanding of the head osteology is necessary, especially in maxillary fractures where diagnosis may be rather difficult. A simplified technic is presented which can be easily followed with the average available dental x-ray unit.—*Am. J. Ortho. and Oral Surg.*, 29:409, August 1943.

S. J. FANALE.

Fractures of the Mandible

LEO WINTER

THE author reviews 50 cases of the use of the Roger Anderson Skeletal Fixation Appliance in mandibular fractures. A good knowledge of the surgical anatomy together with the anatomical hazards is necessary. When considerable muscular displacement is a factor, general endotracheal anesthesia is used. Local anesthesia is obtained either by extra-oral mandibular nerve block, the Labat technic, or the block injection for the inferior alveolar nerve supplemented by an infiltration of the skin surface extra-orally and intra-oral infiltrations for the buccinator nerve. The fracture outlines are penciled on the face, and marks are placed one-half inch above the inferior border of the mandible where the pins are to be inserted. The skin is punctured with a straight jab until bone is reached and with proper support of the fractured fragment a slow hand drilling process is performed and the pins are then inserted at approximately 70 degrees to each other. After proper placement of the pins, each is clamped by a single pin clamp and a rod is fastened through the respective openings in each clamp. Then the clamp bolts are tightened. Reduction of the fracture is accomplished, keeping in mind the occlusion. The bolts of the clamps are tightened and immobilization attained. Advantages of this appliance are its ease of application, complete function of the mandible, minimum of nursing and no feeding problem.—*Am. J. Surg.*, 41:367, September 1943.

S. J. FANALE.

The Diagnosis and Treatment of Ludwig's Angina

ASHBEL C. WILLIAMS and WALTER C. GURALNICK

EXPERIENCES with Ludwig's angina in a series of 20 cases are related in view of the findings in 31 cases previously reported.

The mortality in the present series was 10 per cent, compared with 54 cent in the earlier series.

Criteria for diagnosis are presented briefly.

Emphasis is placed on the role of the teeth and dental procedures as etiologic factors.

Streptococci were present in all cases, and both streptococci and Vincent's organisms in 8 of the 16 cases in which bacteriologic studies were made. Employment of both cultures and smears taken at operation is urged as a basis for the choice of dressings postoperatively. Zinc peroxide dressings are recommended when anaerobes are demonstrated.

Radical surgery, as soon as the diagnosis is established, is advocated.

The surgical technic is outlined. Preliminary exposure of the trachea or tracheotomy prior to operation is advised in every case. Intravenous Pentothal Sodium is recommended as the anesthetic agent of choice.

The use of sulfonamide drugs, either orally or parenterally, is strongly favored. Dependence on sulfonamides without surgery, however, is discouraged.

Under the régime advocated, the ordinary complications of Ludwig's angina have virtually been eliminated.—*New England J. of Med.*, 228:443-450, April 8, 1943.

INCIDENTS OF PRACTICE

Use of Sulfonamides in Cellulitis: Report of Case

S. Joseph Bregstein, D.D.S., Brooklyn, N. Y.

History.—Mrs. G. D., aged 23, presented a chronic purulent pericoronitis of the lower left third molar. The area had been treated previously with hot magnesium sulfate lavages. A roentgenogram verified the diagnosis and indicated the presence of a partially erupted tooth.

Operation.—November 10, 1942, at 4:30 p.m., a mandibular injection of procaine, monocaine and cobefrin (2 cc.) was given with an autoclaved syringe and needle. The tooth was delivered through an incision by means of an elevator. One dermal suture was used. Two sulfanilamide tablets were inserted in the socket. Application of a hot saline solution and ice bags to the face was advised and the patient was told to remain in bed.

Course and Treatment.—November 11, at 9 a.m., the patient was seen at home. There was a slight swelling of the left side of the face. The pain was not very severe during the night. Pentobarbital sodium 1½ grains and acetyl salicylic acid 5 grains, one every three hours as required, were prescribed. The patient was seen again at 7 p.m., when the temperature was 100.3° F. The pain was more severe and the swelling had increased and was harder, particularly along the mandibular border. The skin in the area was shiny and tight. There was no difficulty in deglutition. Slight trismus was present and the general appearance was toxic. The suture was removed and the wound opened for full drainage. The socket was syringed with boiled hot water containing sulfathiazole powder and packed lightly with iodoform gauze and sulfathiazole powder. Frequent mouth lavage with a hot saturated solution of magnesium sulfate was advised; also hot moist poultices applied to the face. Sulfathiazole tablets 7½ grains, two for the first two doses and one thereafter every three hours, each dose to be taken with 10 grains of sodium bicarbonate, were prescribed.

November 12, at 9 p.m., the patient was again seen at home. She had slept well during the night and the pain was much less. The swelling was somewhat harder, resembling that of the ligneous type of cellulitis. An area of fluctuation was noted along the mandibular border, with a circumscribed reddened area. A large bleb on the lip was probably due to the use of hot fomentations. The temperature was 98.9° F. The dressing was changed and the area again washed with a hot sulfathiazole solution. The following treatment was advised: (1) hourly lavage with a hot physiologic sodium chloride solution by means of an enema bag; (2) hot moist applications to the face every hour; (3) continuation of the internal sulfathiazole medication; (4) a sodium bicarbonate enema, and (5) eight glasses of water daily.

November 12, at 9 p.m., the patient was reported by telephone as free from pain, with normal temperature. She had taken food.

November 13, at 1 p.m., she was seen at home. The temperature was 98.9° F. The patient was free from pain and was ambulatory. The swelling was unchanged. There was a hard, red area localized on the face between the first bicuspid and the first molar area. Continuation of the sulfathiazole tablets, every four hours, was advised. The dressing was changed and the socket laved with a hot solution of potassium permanganate. Some crystals of potassium permanganate were provided for frequent use alternately with sodium chloride.

November 14, at 7 p.m., the patient was seen at home. The temperature was 98.9° F. The dressing was changed and the area washed with a hot solution of sodium chloride. Continuation of the sulfathiazole tablets, one every four hours, with continued lavage and application of heat to the face, was advised. There was a purulent viscious discharge and the face was still hard and swollen. Pus was evacuated by careful "milking" of the hard area.

November 15, at 8:30 p.m., the temperature was 98.7° F. The swelling was reduced and the area of hardness was smaller. There was evacuation of a considerable amount of purulent material. The dressing was changed and the area washed and sulfathiazole tablets were prescribed, three times daily, with less frequent lavage.

November 16, at 11 p.m., the patient was seen at the office. The area was washed with a forced spray of a warm alkaline antiseptic and the dressing was changed. The left mandible was exposed to the infrared rays for fifteen minutes. One sulfathiazole tablet was to be taken daily.

November 17, at 6 p.m., the patient was seen at the office. The swelling was much reduced and the hard area was considerably smaller. There was no purulent exudate. The area did, however, bleed freely. The dressing was changed and the socket repacked with a smaller drain of iodoform gauze and sulfathiazole powder. A thirty minutes' application of the infrared rays was given.

November 19, recovery was evident and the dressing was removed.

November 30, the swelling was gone and there was granulation tissue.

December 20, the tissues were normal and the socket was healed.

Frequent roentgenograms taken during and after treatment indicated the course of the cellulitis.

COMMENT

In my experience, sulfathiazole is much more effective in acute infections of the oral tissues than any other sulfonamide. Sulfathiazole is more potent in action on the beta hemolytic streptococcus and *Streptococcus viridans*. Its bacteriostatic activity against *Staphylococcus aureus* and *Staphylococcus albus* is also an important consideration.

It must be remembered that ample fluid intake is essential during treatment and that the action of sodium bicarbonate offsets the side action of sulfathiazole. The local application of sulfathiazole does not hinder repair of tissues. Early institution of local and general medication is an insurance against more serious complications.

454 Seventy-Fifth Street.

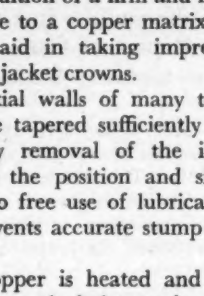
A Working Handle for Matrix Bands

MICHAEL EPSTEIN, D.D.S., New York, N. Y.

The addition of a firm and rigid working handle to a copper matrix band is a valuable aid in taking impressions for porcelain jacket crowns.

The axial walls of many teeth often cannot be tapered sufficiently to permit the ready removal of the impression, owing to the position and size of the pulp. Too free use of lubricants, moreover, prevents accurate stump reproduction.

The copper is heated and the band plunged into alcohol to make it soft and workable. Next, the gingival extremity of the metal is trimmed to conform to the outline of the gum. The metal should



pass an equal distance at all points to just beyond the area of shoulder preparation. Jagged surfaces are polished with fine carborundum stones. A trial impression is now taken to check for any error in the band or the bevel outline. Only a little compound is added to the rim of the band. The compound is chilled, and the necessary adjustments are made. A vertical mark is made in the axial median line and another horizontal mark indicates the contact point of the adjacent tooth. Then the working handle, to be described, is attached. A small opening is cut at a distance of about 2 mm. from the incisal end of the median line, with a No. ½ round bur. This perforation is enlarged for the reception of a threaded pin, and is counter-

sunk from the inside with the shank of an explorer instrument.

We use a threaded flush bold, No. 256, made of brass, size one-half inch, with a countersunk head. The bolt pin is inserted from the inner side, fittting into the countersunk opening, and the nut tightened until it holds securely and the bolt head is flush with the inside surface of the copper band. The cup is now filled with modeling composition, the cervical edge of the band flamed and the projecting pin threaded. This is done to obtain greater adhesion of the metal to the compound.

SECOND IMPRESSION

The tooth is lubricated and again the band is carried to position on the shoulder of the stump, the pin acting as a guide to the axial median line. Then the band is pushed gently to place beyond the edge with the right and left thumb nail, the horizontal contact mark acting as a stop. Now the excess compound is packed into the band with steady pressure, and chilled.

Little effort is needed to remove the impression when vertical traction is applied to the handle. The use of these brass countersunk threaded bolts is recommended where better control of band compound impressions is desired.

15 West Forty-Fourth Street.

A Simple and Accurate Method for Casting Gold Inlays

IRWIN ROBERT LEVY, D.D.S., New York, N. Y.

The so-called modern process of dental casting is actually an adaptation of one of the arts practiced many centuries ago. Knight's American Mechanical Dictionary records the casting of immense bronze statues erected in the Temple of Belus in Babylon, and there is evidence that the Greeks and Romans employed the process with great skill and artistry.

Fundamentally, the technic of gold inlay casting is identical with that of these ancient people. It is called the *Cire Perdue* (Lost Wax) Process, consisting, briefly, of forming a model or pattern in wax, which is embedded in a mold; the wax being then baked out and molten metal poured under pressure into the resulting space.

It must be admitted that many valuable refinements have been made in the process since its adaptation to dentistry. Improvements have been worked out in investments, casting machines, gold, etc. As a result of careful research and experimentation, in which the dental profession and the manufactures of dental materials have collaborated, technics capable of producing remarkably accurate gold inlays have been evolved.

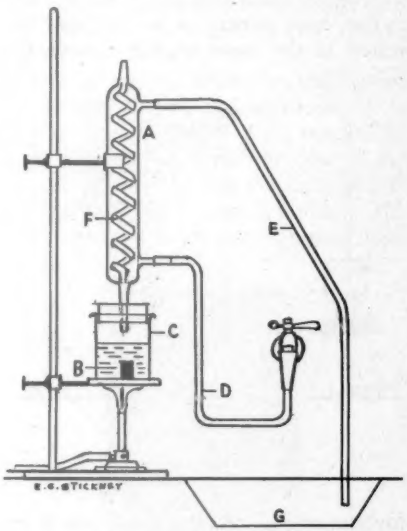


Fig. 1.—A. Condenser, consisting of coil in water jacket. B. Invested inlay immersed in carbon tetrachloride. C. Rubber-stoppered flask into which ends of coil of condenser project. D. Rubber tube from cold water faucet to water jacket of condenser. E. Rubber tube from water jacket to sink. F. Coil in which gases condense.

In spite of excellent results in modern inlay casting, it appears to me that, theoretically at least, there are certain falla-

cies in today's technics, especially the use of excessive heat to which the investment is subjected in baking out the wax and expanding the mold. The temperature recommended varies with different technics, but the most widely accepted appears to be about 1350° F. or that very indefinite index "until a cherry-red glow can be seen in the sprue-hole."

The objects of the technic are: 1. To eliminate the need for excessively high temperatures in baking the mold. 2. To supply a standardized, simple and concise technic.

TECHNIC

The wax pattern is sprued and invested in the usual manner. After the

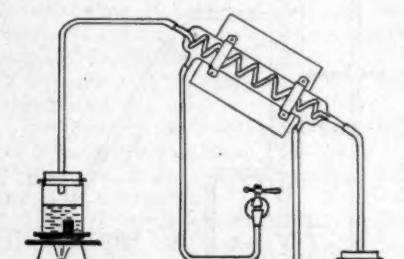


Figure 2.

investment has set, the sprue pin is removed and the invested pattern immersed in carbon tetrachloride and boiled for ten minutes. Examination of a number of molds treated in this fashion has conclusively demonstrated that the chemical has no effect whatever upon the investment, but that all of the wax is expelled, leaving clear, sharp margins.

There is, however, a quantity of retained moisture entrapped in the intermolecular spaces of the investment, which, if casting were attempted at this stage, would form steam and prevent the influx of the molten gold. Then too, the necessity to compensate for the shrinkage of gold as it cools and solidifies is well known, and most inlay investments are made to effect this compensation principally by thermal expansion. Empiric experimentation appears to indicate that, with the investment used (cristobalite), it is necessary only to raise the temperature in which the inlay ring is placed to 650° F. This comparatively low temperature is higher than is necessary to desiccate the mold and seems to produce adequate expansion to counteract the gold shrinkage.

ARMAMENTARIUM

Carbon tetrachloride boils at a very low temperature (170° F.), giving off an odorous, noxious gas which would be dangerous as well as unpleasant in a dental laboratory. The simplest and most effective method that I have found to eliminate this gas is to boil it in an airtight container connected to a glass condenser which consists of a coil surrounded by a jacket or bath of running cold water. The vapors of the boiling carbon tetrachloride condense in the coil and drop back into the container, and the offensive odors are eliminated. Having been immersed in boiling carbon tetrachloride for ten minutes, all traces of wax have disappeared from the mold. As a matter of economy, the condenser can be set at an angle of about 30 degrees and a rubber tube attached to the farther end. It will then act as a still and the condensed vapor, which is redistilled carbon tetrachloride, can be used again and again.

Desiccation and expansion of the mold are achieved by the application of heat. This can best be done by placing the mold in a furnace with a pyrometer and slowly raising the temperature to 650° F. If no pyrometer-equipped furnace is available, satisfactory results can be achieved by placing the inlay ring over a Bunsen flame and resting a thermometer in the crucible. When the thermometer

indicates a temperature of 650° F., the inlay can be cast.

ADVANTAGES

I have found certain advantages in the use of this technic: 1. Well-fitting inlays are produced. 2. The surfaces are cleaner and smoother. 3. Less time is consumed. 4. Because of the use of a set time for wax elimination and a definite temperature for baking, the technic is more concise.

There appear to be many other adaptations of this method, especially the elimination of wax in making acrylic crowns, inlays and dentures.

PHYSICAL PROPERTIES

Tests were conducted to determine the physical properties of gold castings made by this method as compared to those made by the usual, high-heat technic. Two identical wax rods were invested, with the same mix of investment material. One was placed in a furnace and heated to 1350° F. (flask No. 1). The other was immersed in carbon tetrachloride and then heated to 650° F. (flask No. 2). They were carefully cast in the same make and quality of gold.

The results of the tests were:

Flask No. 1: Ultimate strength, 46,500 pounds per square inch.

Elongation, 27 per cent.

Appearance as cast, oxide inclusion; rod oxidized.

Flask No. 2: Ultimate strength, 49,500 pounds per square inch.

Elongation, 25 per cent.

Appearance as cast, sound fracture; natural color.

These tests proved that the ultimate strength and ductility of castings made by the two methods were practically identical, but that oxidation and oxide inclusion were considerably increased by the use of high heat. This would necessarily result in a greater tendency toward "pitting." Visual comparison of the two castings showed that the one cast in Flask No. 1 was dull and blackened, while the casting from Flask No. 2 was bright and shining—almost polished. This phenomenon is probably due to the fact that, owing to the application of excessive heat, sulfides are liberated from the investment, oxidizing the surface of the gold. ($CaSO_4 + CO \rightarrow CaO + CO_2 + SO_2$).

250 West Fifty-Seventh Street.

Resorption of Tooth Root

By WILLIAM H. HOFFMAN, D.M.D., West Brentwood, Long Island, N. Y.

I AM presenting herewith a case report illustrating the ability of the body to heal traumatic injuries to the teeth. The x-ray film shows the absorption of the distal one-eighth inch of the apical length of a lower right lateral incisor. The tooth was fractured at this point about

two years ago at the time of a skull fracture. At the present time, the tooth is functioning well and the only result of the injury apparent is the complete resorption of the broken root apex. Complete calcification of the space which the apex occupied is apparent in the roentgenogram.

Pilgrim State Hospital.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN ACADEMY OF RESTORATIVE DENTISTRY, Chicago, Ill., February 19-20, 1944.

AMERICAN ASSOCIATION OF ORTHODONTISTS, Chicago, Ill., April 25-27, 1944.

DALLAS (TEXAS) MID-WINTER DENTAL CLINIC, January 24-26, 1944.

DENTAL PROTECTIVE ASSOCIATION, Chicago, Ill., December 20.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month, from October to June, at the United States Public Health Service Auditorium, Washington.

THOMAS P. HINMAN MID-WINTER CLINIC, Atlanta, Ga., March 26-28, 1944.

NATIONAL BOARD OF DENTAL EXAMINERS, January 24-25, 1944; May 1-2, 1944.

GREATER NEW YORK DENTAL MEETING, New York, December 6-10.

PAN AMERICAN ODONTOLOGICAL ASSOCIATION, New York, N. Y., December 8.

GREATER PHILADELPHIA ANNUAL MEETING, February 2-4, 1944.

ROOT CANAL THERAPY ORGANIZATION, Chicago, February 1944.

STATE SOCIETIES

January 1944

Rhode Island, at Providence

March 1944

Minnesota, at St. Paul (1-3)

Wisconsin, at Milwaukee (20-22)

April 1944

Virginia, at Richmond (3-5)

May 1944

Georgia, at Atlanta (7-10)

STATE BOARDS OF DENTAL EXAMINERS

Arkansas, at Little Rock, December 20-23. Clarence W. Koch, 817 Donaghey Bldg., Little Rock, Secretary.

Connecticut, at Hartford, December 7-11. Clarence G. Brooks, 302 State St., New London, Recorder.

Idaho, at Boise, December 14-18. Lela D. Painter, Boise, Director, Bureau of Occupational License.

Maine, at Augusta, January 6-8. Carl W. Maxfield, 21 Central St., Bangor, Secretary.

Massachusetts, at Boston, December 27-29. William H. Canavan, 413-N State House, Boston, Secretary.

Minnesota, at Minneapolis, December 13-18. G. R. Metcalf, Barnesville, Secretary.

New Jersey, January 10-15, 1944. J. F. Burke, 150 E. State St., Trenton, Secretary.

North Carolina, at Raleigh, December 27. Wilbur Jackson, Rich Bldg., Clinton, Secretary.

South Carolina, at Columbus, December 20-22. T. C. Sparks, 1508 Washington St., Columbia, Secretary.

Tennessee, at Memphis, December 5-8. W. W. Martin, 115 W. Jefferson Ave., Pulaski, Secretary.

Texas, at Houston, December 14-17. Carl C. Hardin, Jr., Executive Secretary.

Virginia, at Richmond, January 4, 1944. John M. Hughes, 715 Medical Arts Bldg., Richmond, Secretary.

THE AMERICAN ACADEMY OF RESTORATIVE DENTISTRY

THE American Academy of Restorative Dentistry will hold its Annual Meeting at the Palmer House, Chicago, Ill., February 19 and 20, 1944.

W. SAMUEL TUCKER,
Secretary-Treasurer,
940 Canal Building,
New Orleans 12, La.

AMERICAN ASSOCIATION OF ORTHODONTISTS

THE next meeting of the American Association of Orthodontists will be held at the Edgewater Beach Hotel, Chicago, Illinois, April 25, 26, 27, 1944. Members of the

American Dental Association are invited to attend this meeting upon the presentation of proper credentials and payment of the registration fee. Credentials should be obtained in advance from the secretary of the American Association of Orthodontists or a secretary of a constituent orthodontic society.

MAX E. ERNST, *Secretary,*
1250 Lowry Medical Arts Building,
St. Paul 2, Minnesota.

THE THOMAS P. HINMAN MID-WINTER CLINIC

THE Thomas P. Hinman Mid-Winter Clinic will be held at the Municipal Auditorium, Atlanta, Georgia, March 26, 27, 28.

S. A. GARRETT, *Chairman,*
302 Medical Arts Building.
Atlanta, Ga.

DALLAS MID-WINTER DENTAL CLINIC

THE seventeenth annual meeting of the Dallas Mid-Winter Dental Clinic will be held January 24-26, 1944. For further information, address

J. R. TIPTON, *Secretary,*
Medical Arts Bldg.,
Dallas, Texas.

DENTAL PROTECTIVE ASSOCIATION

THE annual meeting of the Dental Protective Association of the United States will be held at the Palmer House, Chicago, December 20, at 5 p.m.

E. W. ELLIOT, *Secretary,*
55 E. Washington St.,
Chicago, Ill.

NATIONAL BOARD OF DENTAL EXAMINERS

THE following are the dates for the next examinations of the National Board of Dental Examiners: January 24-25, 1944; May 1-2, 1944. The dates of the 1944 examinations are subject to change after the executive committee meeting of the Board in Cincinnati in October. Applications should be sent through deans.

GORDON L. TEALL, *Secretary.*

GREATER NEW YORK DENTAL MEETING

THE next Greater New York Dental Meeting will be held in the Hotel Pennsylvania, New York, December 6-10.

S. A. ISAACSON, *Chairman,*
Press and Publication Committee,
Room 106A,
Hotel Pennsylvania,
New York.

PAN AMERICAN ODONTOLOGICAL ASSOCIATION

BECAUSE of transportation difficulties, due to war conditions, the seventh annual dinner meeting of the Pan American Odontological Association will be abbreviated to include primarily the executive committees. The meeting will be held at the Hotel Pennsylvania, New York, December 8, at 7 p.m.

RALPH HOWARD BRODSKY,
Executive Secretary,
14 E. 81st St.,
New York, 28, N. Y.

PAN AMERICAN ODONTOLOGICAL ASSOCIATION SCHOLARSHIP

THE Pan American Odontological Association takes pleasure in announcing an annual scholarship at the Tufts College Dental School, Boston, Mass., for graduate dentists from any of the Latin American countries. The subjects of study include: complete denture prosthesis, partial denture prosthesis, minor oral surgery, operative dentistry, ceramics, children's dentistry, root surgery and radiology, preventive dentistry and treatment of parodontal diseases.

This annual scholarship is an addition to the already available Pan American Odontological Association scholarships at the New York University, College of Dentistry; Evans Dental Institute, School of Dentistry, University of Pennsylvania; and the W. K. Kellogg Foundation Institute, Graduate and Postgraduate Dentistry, University of Michigan.

RALPH HOWARD BRODSKY, D.M.D.,
Executive-Secretary,
14 East 81st Street,
New York 28, N. Y.

GREATER PHILADELPHIA ANNUAL MEETING

THE Greater Philadelphia Annual Meeting will be held February 2-4, 1944 at the Benjamin Franklin Hotel.

JOHN P. LOOBY, *Chairman,*
Publicity Committee.

ROOT CANAL THERAPY ORGANIZATION

AT the Midwinter Meeting of the Chicago Dental Society, a national group for the study of root canal therapy was organized. W. Clyde Davis was made president, and John H. Hospers, secretary-treasurer. Committees were appointed to draw up a constitution and to select a name, to be submitted at the next regular meeting, in Chicago in February 1944. It is hoped that all those who are interested in this fundamental phase of dentistry will associate themselves with the group. Those joining before the final organization will be considered charter members. Annual dues were temporarily set at $2. All correspondence should be addressed to

JOHN H. HOSPERS, *Secretary,*
25 E. Washington St.,
Chicago, Ill.

GEORGIA DENTAL ASSOCIATION

THE seventy-sixth annual meeting of the Georgia Dental Association will be held in Atlanta, May 7-10, 1944, with headquarters at the Ansley Hotel.

R. H. MURPHY, *Secretary,*
605 Bankers Insurance Bldg.,
Macon.

MINNESOTA STATE DENTAL ASSOCIATION

THE sixty-first annual session of the Minnesota State Dental Association will be held in the Municipal Auditorium, St. Paul, March 1-3, 1944. All members of the American Dental Association are invited to attend.

L. M. CRUTTENDEN, *Secretary,*
498 Lowry Bldg.,
St. Paul.

RHODE ISLAND STATE DENTAL SOCIETY

THE next meeting of the Rhode Island State Dental Society will be held in Providence in January 1944.

CHARLES F. MCKIVERGAN,
Secretary Pro Tem.,
102 Waterman St.,
Providence.

VIRGINIA STATE DENTAL ASSOCIATION

THE Virginia State Dental Association will hold its next annual meeting April 3-5, 1944 at the John Marshall Hotel, Richmond.

J. E. JOHN, *Secretary,*
Medical Arts Bldg.,
Roanoke.

WISCONSIN STATE DENTAL SOCIETY

THE Wisconsin State Dental Society will hold its seventy-fourth annual convention at the Hotel Schroeder, Milwaukee, March 20-22, 1944. A meeting of the executive council and house of delegates will precede the general convention March 19, 1944.

KENNETH F. CRANE, *Secretary,*
1233 Bankers Bldg.,
Milwaukee.

ARKANSAS STATE BOARD OF DENTAL EXAMINERS

THE Arkansas State Board of Dental Examiners will conduct the next examination of applicants for dental licensure at Little Rock, December 20, 21, 22, 23. All applications must be filed with the secretary not later than December 10.

CLARENCE W. KOCH, *Secretary,*
817 Donaghey Building,
Little Rock, Ark.

CONNECTICUT DENTAL COMMISSION

THE Connecticut Dental Commission will meet in Hartford, December 7-11, for examination of applicants for license to practice dentistry and dental hygiene and to transact any other business proper to come before it. Applications should be in the hands of the recorder at least ten days before the meeting. For application blanks and further information, apply to

CLARENCE G. BROOKS, *Recorder,*
302 State St.,
New London.

IDAHO BOARD OF DENTAL EXAMINERS

THE examination for license to practice dentistry in Idaho usually held in August was postponed and will be held in Boise, December 14-18.

LELA D. PAINTER, *Director,*
Bureau of Occupational License,
Boise, Idaho.

MAINE STATE BOARD OF DENTAL EXAMINERS

THE next examination of the Maine State

Board of Dental Examiners will be held in the State House, Augusta, Maine on January 6-8, 1944. All credentials must be in the hands of the secretary at least ten days prior to the date of the examination. For application blanks and information, address,

CARL W. MAXFIELD, D.M.D.,
Secretary,
31 Central St.,
Bangor, Maine.

MASSACHUSETTS BOARD OF DENTAL EXAMINERS

THE Massachusetts Board of Dental Examiners will hold its next examinations December 27-29. All applicants must file their credentials with the secretary at least thirty days in advance. For further information, address

WILLIAM H. CANAVAN, *Secretary,*
413-N State House,
Boston.

MINNESOTA STATE BOARD OF DENTAL EXAMINERS

THE next examination of the Minnesota State Board of Dental Examiners will be held at the College of Dentistry, University of Minnesota, Minneapolis, December 13-18. All examination fees must be in the hands of the secretary at least ten days before the date of the examination. Address all communications to

G. R. METCALF, *Secretary,*
Barnesville.

STATE BOARD OF REGISTRATION AND EXAMINATION IN DENTISTRY OF NEW JERSEY

THE State Board of Registration and Examination in Dentistry of New Jersey will hold its next examinations January 10-15, 1944. A copy of the requirements and rules, instruction sheet and preliminary application blank will be sent on request. Preliminary application blanks, together with the examination fee of $25, should be sent to the secretary on or before November 15.

J. F. BURKE, *Acting Secretary,*
150 E. State St.,
Trenton.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the North Carolina State Board of Dental Examiners for the examination of applicants for licensure will be held at the State Capitol, Raleigh, beginning December 27. Applications must be filed with the secretary thirty days before the examination. For application blanks and further information, address

WILBUR JACKSON, *Secretary,*
Rich Bldg.,
Clinton.

SOUTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE South Carolina State Board of Dental Examiners will hold its next meeting in Columbia December 20-22. All applications must be filed with the secretary at least thirty days before the examinations.

T. C. SPARKS, *Secretary,*
1508 Washington St.,
Columbia.

TENNESSEE BOARD OF DENTAL EXAMINERS

THE Tennessee Board of Dental Examiners will hold its next examination at the College of Dentistry, University of Tennessee, Memphis, December 5-8. All candidates must report to the board at 1 p.m., Sunday, December 5, at the Peabody Hotel, ready to take the examination. For further information, address

W. W. MARTIN, *Secretary,*
115 W. Jefferson Ave.,
Pulaski.

TEXAS STATE BOARD OF DENTAL EXAMINERS

THE next examination by the Texas State Board of Dental Examiners will be held in Houston, Texas, December 14 through 17, 1943, both dates inclusive.

Written examinations will be given in these subjects: dental materials and biochemistry (physiological chemistry), diagnosis and treatment planning, dental surgery, bacteriology and pathology, materia medica, oral hygiene and prophylaxis, prosthetic dentistry, operative dentistry, orthodontia and periodontia, anatomy and dental anatomy, physiology, anesthesia.

The practical subjects will be: amalgam filling, extraction, gold foil, set-up and inlay.

CARL C. HARDIN, JR.
Executive Secretary.

VIRGINIA STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the Virginia State Board of Dental Examiners will be held at the Medical College of Virginia, Richmond, beginning at 9 a.m., January 4, 1944. No applications will be accepted after December 20. Incomplete applications will be rejected and returned. For application blanks and further information, address

JOHN M. HUGHES, *Secretary,*
715 Medical Arts Bldg.,
Richmond.

VOLUNTEERSHIPS AND EXTERNSHIPS, BRONX HOSPITAL

THERE are several volunteerships and externships available for recent graduates at the dental clinic, Bronx Hospital, in the following departments: oral surgery and exodontia, operative dentistry, orthodontia, surgical periodontia and root canal therapy. Applicants address David Wurzel, director of the Dental Department, Bronx Hospital, 169th St. & Fulton Ave., Bronx, New York.

DENTAL INTERNSHIPS

Two internships are available at the St. Louis City Hospital for recent dental graduates. Opportunity is afforded for training and experience in dental and oral surgery, diagnosis and other phases of dentistry. Applicants should address Leo J. Wade, Medical Director, or Hamilton B. G. Robinson, D.D.S., City Hospital, 1515 Lafayette Ave., St. Louis, Mo.

DENTAL INTERNSHIPS

THE Greater New York Conference of Hospital Dental Services, comprised of a group of men who are chiefs of dental services, would like to aid those men seeking dental internships in hospitals in the metropolitan area. Those who are not in the Army or the Navy and who are desirous of obtaining internships should communicate with

MARY E. REILLY, *Secretary,*
386 Fourth Ave.,
New York, N. Y.

EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS OF THE NAVY

THE next examination for appointment as Assistant Dental Surgeon, U. S. Navy (lieutenant [junior grade], Dental Corps, U. S. Navy) will be held at the Naval Training Station, Norfolk, Va., the Naval Training Station, Great Lakes, Ill., the Naval Training Station, San Diego, Calif. and the Naval Dental School, National Naval Medical Center, Bethesda, Md., January 24, 1944. Application for this examination should be made to the chief of the Bureau of Medicine and Surgery, Navy Department, Washington, D. C. Applicants for appointment as Assistant Dental Surgeon must be citizens of the United States, more than 21, but less than 32 years of age at the time of acceptance of appointment, and graduates of a Class A dental school. A circular of information listing physical and other requirements for appointment, subjects in which applicants are examined and other data pertaining to salary, allowances, etc., can be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C., on request.

UNIVERSITY OF CALIFORNIA RESEARCH ASSISTANT

THE College of Dentistry University of California has an appointment as research assistant available for a qualified person beginning June 30, 1944. The appointment is in the Division of Dental Medicine and is for one year. This may be extended for an additional year.

This appointment is designed primarily for dental graduates with an interest in dental research and teaching. However, this dental degree requirement can be waived if other qualifications justify it.

The basic salary is $1500 a year, plus an emergency increase to care for added living costs.

Application forms may be obtained from the Dean of the College of Dentistry, University of California, San Francisco, California.

WILLARD C. FLEMING, *Dean.*